Military Department,

REPORT

OF THE

TESTS OF METALS

AND

OTHER MATERIALS

FOR

INDUSTRIAL PURPOSES

MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL, MASSACHUSETTS,

DURING THE

FISCAL YEAR ENDED JUNE 30, 1905.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

1905 WATERTOWN ARSENAL,
Watertown, Mass., October 18, 1905.

SIR: I have the honor to submit herewith the annual report of tests of iron and steel and other materials made at this arsenal during the fiscal year ended June 30, 1905.

The total number of specimens tested during the year was classified as follows:

Gun specimens	37
For Ordnance Department	2,107
For other Government departments	293
Investigative tests	265
Tests for private parties	933
Total	3,635

The receipts and expenditures were as follows:

Amount appropriated for testing machine and testing work	$15,000.00
Received from private parties	1,108.07
Total received	16,108.07
Amount expended for services and labor	14,068.55
Amount expended for light, power, tools, implements, and materials for tests	1,293.29
Deposited to credit of Treasurer of United States	746.23
Total expended	16,108.07

The larger number of specimens tested and a considerable part of the time of the testing laboratory was occupied during the past fiscal year in current material for the Ordnance Department and other departments of the Government. This work, however, is chiefly of a routine nature, in which interest centers on the procurement of material which will meet the prescribed properties called for in the governing specifications.

In addition to the usual routine tests, there was a series of tests made on the resistance of jacketed bullets for .30-caliber rifle barrels. The resistance of bullets, forced through the bore, was determined with a new barrel, and again after 3,500 rounds had been fired.

An extended series of tests was made on the strength and rigidity of wheels for field carriages and limbers.

Tests on the endurance of different grades of steel to repeated alternate stresses have been continued from former years.

A number of observations were made on the contraction in length of steel bars cooled in a bath of liquid air.

The tensile strength of a steel bar was also determined, which was cooled and tested while immersed in a bath of liquid air. This sample showed a gain in strength of 35.5 per cent over its strength at ordinary atmospheric temperature. While the steel displayed a contraction of area at the place of rupture not much below its normal value, there was no general elongation of the steel remote from the contraction in the immediate vicinity of the rupture.

The tests of concrete and mortar columns and of brick piers are continued.

General interest attaches to the use of concrete, both plain and reënforced with steel, and the current series of column tests is intended to include representative columns of the various types of reënforcement

which are being used in engineering and architectural construction. Other columns of the series have been prepared, of various types of reënforcement, and are awaiting a suitable period of hardening to elapse before being tested.

It is shown by the tests that the use of mixtures of richer or leaner proportions of cement and aggregate influences the rigidity of the indurated material in a marked degree, as well as modifying the ultimate strength.

F. E. HOBBS,
Major, Ordnance Department, U. S. Army, Commanding.

The CHIEF OF ORDNANCE U. S. ARMY,
Washington, D. C.

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3-INCH R. F. GUNS.

SPECIMENS FROM TUBES, JACKETS, LOCKING HOOPS, BREECHBLOCKS, AND CLIPS.

TUBE.

No. 8070.

Marks, $\frac{47068\ B_1}{BT_2M}$

Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00005	.00005	0.	0.	
10,000	.00025	.00020	.....	.....	
30,000	.00100	.00075	.....	.....	
40,000	.00135	.00035	.....	.....	
50,000	.00165	.00030	0.	0.	
55,000	.00190	.00025	.....	.....	
60,000	.00205	.00015	.....	.....	
65,000	.00230	.00025	.....	.....	
70,000	.00250	.00020	.....	.....	
71,000	.00250	0.	.....	.....	Elastic limit.
72,000	.00450	.00200	.....	.....	
73,000	.00605	.00155	.....	.....	
74,000	.01250	.00645	.....	.....	
75,000	.01805	.00555	.....	.....	
110,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	110,500
Elastic limit per square inch of original section	do...	71,000
Elongation per inch after rupture	inch..	.160
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		".40 from the neck
Character of broken surface		silky
Elongation of inch sections		".21*, ".11

TUBE.

No. 8077.

Marks, $\frac{39608\ B_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive Elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00025	.00025	0.	0.	
10,000	.00060	.00025	.....	.....	
30,000	.00115	.00065	.....	.....	
40,000	.00150	.00035	.....	.....	
50,000	.00195	.00045	0.	0.	
55,000	.00205	.00010	.....	.....	
60,000	.00230	.00025	.....	.....	
65,000	.00255	.00025	.....	.....	
67,000	.00260	.00005	.....	.....	Elastic limit.
68,000	.00740	.00480	.....	.....	
69,000	.01015	.00275	.....	.....	
70,000	.01110	.00095	.....	.....	
105,500	.....	.....	.....	.....	Tensile strength.

General Summary.

Tensile strength per square inch of original section	pounds..	105,500
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.205
Elongation per inch under strain at elastic limit	do...	.00260
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		".50 from the neck
Character of broken surface		silky
Elongation of inch sections		".12, ".29*

TUBE.

No. 8082.

Marks, $\frac{40393\ B_3}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00005	.00005	0.	0.	
10,000	.00015	.00010			
30,000	.00070	.00065			
40,000	.00105	.00035			
50,000	.00145	.00040	0.	0.	
55,000	.00150	.00005			
60,000	.00170	.00020			
65,000	.00185	.00015			
70,000	.00210	.00025			
75,000	.00225	.00015			
76,000	.00225	0.			Elastic limit.
77,000	.01825	.01600			
78,000	.01895	.00070			
79,000	.02050	.00155			
106,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	106,000
Elastic limit per square inch of original section	do...	76,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00225
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".60 from the neck
Character of broken surface		silky
Elongation of inch sections		".28*, ".09

TUBE.

No. 8084.

Marks, $\frac{39564\ B_2}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
40,000	.00135	.00035	.....	.....	
50,000	.00170	.00035	0.	0.	
55,000	.00185	.00015	.....	.....	
60,000	.00205	.00020	.....	.....	
65,000	.00220	.00015	.....	.....	
68,000	.00230	.00010	.....	.....	
69,000	.00235	.00005	.....	.....	Elastic limit.
70,000	.00460	.00225	.....	.....	
71,000	.00575	.00115	.....	.....	
72,000	.00785	.00210	.....	.....	
104,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,000
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch..	.175
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		".70 from the neck
Character of broken surface		silky
Elongation of inch sections		".09, ".26*

TUBE.

No. 8093.

Marks, $^{47075\ B_3}_{BT_4M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00025	.00010	.....	.....	
30,000	.00090	.00065	.....	.....	
40,000	.00125	.00035	.....	.....	
50,000	.00160	.00035	0.	0.	
55,000	.00175	.00015	.....	.....	
60,000	.00195	.00020	.....	.....	
65,000	.00215	.00020	.....	.....	
70,000	.00230	.00015	.....	.....	
72,000	.00240	.00010	.....	.....	
73,000	.00245	.00005	.....	.....	Elastic limit.
74,000	.00300	.00055	.....	.....	
75,000	.00430	.00130	.....	.....	
76,000	.00555	.00125	.....	.....	
120,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	120,500
Elastic limit per square inch of original section	do...	73,000
Elongation per inch after rupture	inch..	.160
Elongation per inch under strain at elastic limit	do...	.00245
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		".60 from the neck
Character of broken surface		fine granular, 60 per cent; silky, 40 per cent
Elongation of inch sections		".10, ".22*

TUBE.

No. 8099.

Marks, $\frac{40396\ B_3}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015			
30,000	.00090	.00060			
40,000	.00125	.00035			
50,000	.00160	.00035	0.	0.	
55,000	.00175	.00015			
60,000	.00200	.00025			
65,000	.00210	.00010			
70,000	.00230	.00020			
71,000	.00235	.00005			Elastic limit.
72,000	.00545	.00310			
73,000	.01030	.00485			
74,000	.01135	.00106			
105,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	105,000
Elastic limit per square inch of original section	do...	71,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".8 from the neck
Character of broken surface		silky
Elongation of inch sections		".26*, ".11

TUBE.

No. 8105.

Marks, $\frac{47501\ B_4}{BT_eM}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00025	.00010	.....	.....	
30,000	.00090	.00065	.....	.....	
40,000	.00120	.00030	.....	.....	
50,000	.00165	.00045	0.	0.	
55,000	.00180	.00015	.....	.....	
60,000	.00195	.00015	.....	.....	
65,000	.00220	.00025	.....	.....	
67,000	.00235	.00015	.....	.....	Elastic limit.
68,000	.01050	.00815	.....	.....	
69,000	.01150	.00100	.....	.....	
70,000	.01275	.00125	.....	.....	
101,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	101,000
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		".70 from the neck
Character of broken surface		silky
Elongation of inch sections		".14, ".28*

TUBE.

No. 8107.

Marks, $\frac{47213\ B_1F_1}{BT_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	.....	.....	
30,000	.00090	.00070	.....	.....	
40,000	.00125	.00035	.....	.....	
50,000	.00160	.00035	0.	0.	
55,000	.00175	.00015	.....	.....	
60,000	.00190	.00015	.....	.....	
65,000	.00210	.00020	.....	.....	
70,000	.00230	.00020	.....	.....	
75,000	.00250	.00020	.....	.....	
80,000	.00270	.00020	.....	.....	Elastic limit.
81,000	.01500	.01230	.....	.....	
82,000	.01535	.00035	.....	.....	
88,000	.01650	.00115	.....	.....	
113,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	113,000
Elastic limit per square inch of original section	do...	80,000
Elongation per inch after rupture	inch..	.245
Elongation per inch under strain at elastic limit	do...	.00270
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.8
Position of rupture		1″ from the neck
Character of broken surface		silky
Elongation of inch sections		″.25*, ″.24

JACKET.

No. 8081.

Marks, $\frac{47121\ B_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00095	.00070	.....	.....	
40,000	.00135	.00040	.....	.....	
50,000	.00165	.00030	0.	0.	
55,000	.00185	.00020	.....	.....	
60,000	.00200	.00015	.....	.....	
65,000	.00215	.00015	.....	.....	
70,000	.00235	.00020	.....	.....	
72,000	.00245	.00010	.....	.....	
73,000	.00250	.00005	.....	.....	Elastic limit.
74,000	.01165	.00915	.....	.....	
75,000	.01250	.00085	.....	.....	
76,000	.01320	.00070	.....	.....	
112,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	112,500
Elastic limit per square inch of original section	do...	73,000
Elongation per inch after rupture	inch..	.175
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.065
Reduction in area after rupture, per cent of original section		23.9
Position of rupture		1 ".05 from the neck
Character of broken surface		silky
Elongation of inch sections		".20, ".15

JACKET.

No. 8086.

Marks, $\frac{47877\ B_1}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00090	.00065	.....	.....	
40,000	.00125	.00035	.....	.....	
50,000	.00155	.00030	0.	0.	
55,000	.00180	.00025	.....	.....	
60,000	.00190	.00010	.....	.....	
65,000	.00205	.00015	.....	.....	
70,000	.00220	.00015	.....	.....	
75,000	.00240	.00020	.....	.....	
76,000	.00250	.00010	.....	.....	
77,000	.00255	.00005	.....	.....	Elastic limit.
78,000	.00690	.00335	.....	.....	
79,000	.00875	.00185	.....	.....	
80,000	.01000	.00125	.....	.....	
114,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,000
Elastic limit per square inch of original section	do...	77,000
Elongation per inch after rupture	inch..	.145
Elongation per inch under strain at elastic limit	do...	.00255
Reduction of diameter at point of rupture	do...	.065
Reduction in area after rupture, per cent of original section		20.5
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		".17*, ".12

JACKET.

No. 8092.

Marks, $\frac{47709\ B_1}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00025	.00010	.....	.....	
30,000	.00090	.00065	.....	.....	
40,000	.00130	.00040	.....	.....	
50,000	.00170	.00040	0.	0.	
55,000	.00190	.00020	.....	.....	
60,000	.00205	.00015	.....	.....	
65,000	.00225	.00020	.....	.....	
68,000	.00240	.00015	.....	.....	
69,000	.00250	.00010	.....	.....	Elastic limit.
70,000	.00525	.00275	.....	.....	
71,000	.00760	.00235	.....	.....	
72,000	.00835	.00075	.....	.....	
111,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	111,000
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch..	.195
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".70 from the neck
Character of broken surface		silky
Elongation of inch sections		".10, ".29*

JACKET.

No. 8096.

Marks, $\frac{47877\ B_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	.....	.....	
30,000	.00095	.00075	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00170	.00045	0.	0.	
55,000	.00180	.00010	.....	.....	
60,000	.00190	.00010	.....	.....	
65,000	.00205	.00015	.....	.....	
70,000	.00285	.00080	.....	.....	
75,000	.00250	.00015	.....	.....	
77,000	.00260	.00010	.....	.....	Elastic limit.
78,000	.00315	.00055	.....	.....	
79,000	.01085	.00770	.....	.....	
80,000	.01170	.00085	.....	.....	
119,000	.....	.....	.....	.....	Tensile strenth.

General summary.

Tensile strength per square inch of original section	pounds..	119,000
Elastic limit per square inch of original section	do...	77,000
Elongation per inch after rupture	inch..	.180
Elongation per inch under strain at elastic limit	do...	.00260
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".9 from the neck
Character of broken surface		silky
Elongation of inch sections		".11, ".25

JACKET.

No. 8098.

Marks, $\frac{47396\ B_2}{BT_2M.}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
30,000	.00105	.00075	.....	.....	
40,000	.00145	.00040	.....	.....	
50,000	.00175	.00030	0.	0.	
55,000	.00190	.00015	.....	.....	
60,000	.00210	.00020	.....	.....	
65,000	.00225	.00015	.....	.....	
70,000	.00245	.00020	.....	.....	
72,000	.00250	.00005	.....	.....	
73,000	.00255	.00005	.....	.....	Elastic limit.
74,000	.00285	.00030	.....	.....	
75,000	.00450	.00165	.....	.....	
76,000	.00600	.00150	.....	.....	
114,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,000
Elastic limit per square inch of original section	do...	73,000
Elongation per inch after rupture	inch..	.195
Elongation per inch under strain at elastic limit	do...	.00255
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		".70 from the neck
Character of broken surface		silky
Elongation of inch sections		".27*, ".12

JACKET.

No. 8101.

Marks, $\frac{47708\ B_2}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00085	.00020	.....	.....	
30,000	.00095	.00060	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00155	.00030	0.	0.	
55,000	.00175	.00020	.....	.....	
60,000	.00190	.00015	.....	.....	
65,000	.00210	.00020	.....	.....	
69,000	.00225	.00015	.....	.....	
70,000	.00230	.00005	.....	.....	Elastic limit.
71,000	.00295	.00065	.....	.....	
72,000	.00720	.00425	.....	.....	
73,000	.00775	.00055	.....	.....	
114,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,500
Elastic limit per square inch of original section	do...	70,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00230
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		".9 from the neck
Character of broken surface		silky
Elongation of inch sections		".28*, ".12

JACKET.

No. 8103.

Marks, $\frac{47142\ B_3}{BT_2M}$.
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
30,000	.00095	.00065	.....	.....	
50,000	.00155	.00060	0.	0.	
55,000	.00180	.00025	.....	.....	
60,000	.00200	.00020	.....	.....	
65,000	.00220	.00020	.....	.....	
70,000	.00250	.00030	.....	.....	
73,000	.00265	.00015	.....	.....	Elastic limit.
74,000	.02000	.01735	.....	.....	
75,000	.02150	.00150	.....	.....	
76,000	.02300	.00150	.....	.....	
103,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	103,500
Elastic limit per square inch of original section	do...	73,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	.00265
Reduction in diameter at point of rupture	do...	.075
Reduction in area after rupture, per cent of original section		27.4
Position of rupture		".80 from the neck
Character of broken surface		dull silky
Elongation of inch sections		".24*, ".14

JACKET.

No. 8104.

Marks, $\frac{47121\ B_2}{BT_4M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	.....	.....	
30,000	.00095	.00060	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00160	.00035	0.	0.	
55,000	.00175	.00015	.....	.....	
60,000	.00190	.00015	.....	.....	
65,000	.00205	.00015	.....	.....	
70,000	.00225	.00020	.....	.....	
75,000	.00245	.00020	.....	.....	
78,000	.00260	.00015	.....	.....	Elastic limit.
79,000	.01050	.00790	.....	.....	
80,000	.01175	.00125	.....	.....	
81,000	.01250	.00075	.....	.....	
119,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	119,000
Elastic limit per square inch of original section	do...	78,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00260
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		".22*, ".15

LOCKING HOOP.

No. 8083.

Marks, $\frac{47142\ B_2F_1}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
40,000	.00135	.00035	.....	.....	
50,000	.00175	.00040	0.	0.	
55,000	.00185	.00010	.....	.....	
60,000	.00200	.00015	.....	.....	
65,000	.00225	.00025	.....	.....	
70,000	.00240	.00015	.....	.....	
75,000	.00275	.00035	.....	.....	
76,000	.00280	.00005	.....	.....	Elastic limit.
77,000	.00305	.00025	.....	.....	
78,000	.02096	.01790	.....	.....	
79,000	.02120	.00025	.....	.....	
107,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	107,000
Elastic limit per square inch of original section	do...	76,000
Elongation per inch after rupture	inch..	.220
Elongation per inch under strain at elastic limit	do...	.00280
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		1".25 from the neck
Character of broken surface		silky, oblique
Elongation of inch sections		".18, ".26*

Locking Hoop.

No. 8095.

Marks, $\frac{47230\ B_2F_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
20,000	.00055	.00030	.....	.....	
30,000	.00090	.00035	.....	.....	
50,000	.00165	.00075	0.	0.	
55,000	.00180	.00015	.....	.....	
60,000	.00200	.00020	.....	.....	
65,000	.00215	.00015	.....	.....	
74,000	.00265	.00050	.....	.....	Elastic limit.
75,000	.00315	.00050	.....	.....	
76,000	.00395	.00080	.....	.....	
77,000	.00600	.00205	.....	.....	
108,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	108,000
Elastic limit per square inch of original section	do...	74,000
Elongation per inch after rupture	inch..	.160
Elongation per inch under strain at elastic limit	do...	.00265
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		".70 from the neck
Character of broken surface		silky
Elongation of inch sections		".23", ".09

BREECHBLOCK.

No. 8067.

Marks, $\frac{46740\ B_2F_5}{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00050	.00050	0.	0.	
30,000	.00075	.00025	.....	.....	
50,000	.00140	.00065	0.	0.	
55,000	.00160	.00020	.....	.....	
60,000	.00175	.00015	.....	.....	
65,000	.00190	.00015	.....	.....	
70,000	.00210	.00020	.....	.....	
75,000	.00225	.00015	.....	.....	
80,000	.00240	.00015	.....	.....	
85,000	.00265	.00025	.....	.....	
87,000	.00280	.00015	.....	.....	Elastic limit.
88,000	.00320	.00040	.....	.....	
89,000	.00420	.00100	.....	.....	
90,000	.00520	.00100	.....	.....	
91,000	.00605	.00085	.....	.....	
131,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	131,000
Elastic limit per square inch of original section	do...	87,000
Elongation per inch after rupture	inch..	.165
Elongation per inch under strain at elastic limit	do...	.00280
Reduction in diameter at point of rupture	do...	.106
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".70 from the neck
Character of broken surface		fine silky
Elongation of inch sections		".10, ".23*

BREECHBLOCK.

No. 8072.

Marks, $\frac{45634\ B_2F_1}{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00020	.00020	0.	0.	
40,000	.00155	.00135	.....	.....	
70,000	.00260	.00105	0.	0.	
75,000	.00275	.00015	.....	.....	
76,000	.00280	.00005	.....	.....	Elastic limit.
77,000	.00305	.00025	.....	.....	
78,000	.00360	.00055	.....	.....	
79,000	.00490	.00130	.....	.....	
80,000	.00750	.00260	.....	.....	
122,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	122,000
Elastic limit per square inch of original section	do...	76,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00280
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		".90 from the neck
Character of broken surface		silky
Elongation of inch sections		".23*, ".14

CLIPS.

No. 8091.

Marks, $\frac{47206\ B_2F_1}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00020	.00020	0.	0.	
10,000	.00040	.00020	.....	.....	
30,000	.00110	.00070	.....	.....	
40,000	.00140	.00030	.....	.....	
44,000	.00155	.00015	0.	0.	
50,000	.00175	.00020	0.	0.	
55,000	.00190	.00015	.....	.....	
60,000	.00210	.00020	.....	.....	
65,000	.00230	.00020	.....	.....	
66,000	.00235	.00005	.....	.....	
67,000	.00245	.00010	.....	.....	Elastic limit.
68,000	.01550	.01305	.....	.....	
69,000	.01620	.00070	.....	.....	
70,000	.01700	.00080	.....	.....	
100,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	100,500
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.195
Elongation per inch under strain at elastic limit	do...	.00245
Reduction in diameter at point of rupture	do...	.075
Reduction in area after rupture, per cent of original section		27.4
Position of rupture		".75 from the neck
Character of broken surface		silky
Elongation of inch sections		".14, ".25*

CLIPS.

No. 8097.

Marks, $\frac{47204\ B_4F_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00095	.00065	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00165	.00040	0.	0.	
55,000	.00180	.00015	.....	.....	
60,000	.00200	.00020	.....	.....	
61,000	.00205	.00005	.....	.....	Elastic limit.
62,000	.00265	.00060	.....	.....	
63,000	.00495	.00230	.....	.....	
64,000	.01055	.00560	.....	.....	
100,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	100,500
Elastic limit per square inch of original section	do...	61,000
Elongation per inch after rupture	inch..	.170
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.055
Reduction in area after rupture, per cent of original section		20.5
Position of rupture		1".20 from the neck
Character of broken surface		silky
Elongation of inch sections		".18*, ".16*

TABULATION OF TENSION SPECIMENS FROM 3-INCH R. F. GUNS.

STEMS 2" LONG, ".505 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
8070	Tube	Middle	71,000	110,500	16.0	30.7	Silky	Breech end.
8077	do	do	67,000	105,500	20.5	43.3	do	Do.
8082	do	do	76,000	106,000	18.5	37.1	do	Do.
8084	do	do	69,000	104,000	17.5	34.0	do	Do.
8098	do	do	73,000	120,500	16.0	30.7	Granular, 60 per cent; silky, 40 per cent.	Do.
8099	do	do	71,000	105,000	18.5	37.1	Silky	Do.
8105	do	do	67,000	101,000	21.0	40.3	do	Do.
8107	do	do	80,000	113,000	24.5	40.3	do	Do.
8081	Jacket	do	73,000	112,500	17.5	23.9	do	Do.
8086	do	do	77,000	114,000	14.5	20.5	do	Do.
8092	do	do	69,000	111,000	19.5	37.1	do	Do.
8096	do	do	77,000	119,000	18.0	37.1	do	Do.
8098	do	do	73,000	114,000	19.5	40.3	do	Do.
8101	do	do	70,000	114,500	20.0	40.3	do	Do.
8103	do	do	73,000	103,500	19.0	27.4	do	Do.
8104	do	do	73,000	119,000	18.5	37.1	do	Do.
8083	Locking hoop	do	76,000	107,000	22.0	34.0	do	Do.
8095	do	do	74,000	108,000	16.0	34.0	do	Do.
8067	Breechblock	do	87,000	131,000	16.5	37.1	do	
8072	do	do	76,000	122,000	18.5	34.0	do	
8091	Clips	do	67,000	100,500	19.5	27.4	do	
8097	do	do	61,000	100,500	17.0	20.5	do	

6-INCH R. F. GUNS.

SPECIMENS FROM TUBES, JACKETS, AND BREECH-BLOCKS.

TUBE.

No. 8008.

Marks, $\frac{6RF\,30T}{MT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00085	.00060	.....	.....	
40,000	.00115	.00060	.....	.....	
50,000	.00145	.00080	0.	0.	
55,000	.00160	.00015	.....	.....	
60,000	.00175	.00015	.....	.....	
65,000	.00195	.00020	.....	.....	
67,000	.00205	.00010	.....	.....	Elastic limit.
68,000	.00855	.00150	.....	.....	
69,000	.00500	.00145	.....	.....	
70,000	.00755	.00255	.....	.....	
109,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	109,500
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.205
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.155
Reduction in area after rupture, per cent of original section		51.9
Position of rupture		".65 from the neck
Character of broken surface		silky
Elongation of inch sections		".09, ".32*

TUBE.

No. 8011.

Marks, $\frac{6RF\ 35T}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00090	.00065	.....	.....	
40,000	.00125	.00035	.....	.....	
50,000	.00155	.00030	0.	0.	
55,000	.00175	.00020	.....	.....	
60,000	.00190	.00015	.....	.....	
63,000	.00205	.00015	.....	.....	Elastic limit.
64,000	.01120	.00915	.....	.....	
65,000	.01180	.00060	.....	.....	
66,000	.01365	.00185	.....	.....	
95,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	95,500
Elastic limit per square inch of original section	do...	63,000
Elongation per inch after rupture	inch..	.285
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.145
Reduction in area after rupture, per cent of original section		49.1
Position of rupture		1".03 from the neck
Character of broken surface		fine silky
Elongation of inch sections		".32*, ".15

TUBE.

No. 8612.

Marks, $\frac{42348\ B_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00080	.00015	.....	.....	
30,000	.00105	.00075	.....	.....	
40,000	.00135	.00080	.....	.....	
50,000	.00170	.00085	0.	0.	
55,000	.00185	.00015	.....	.....	
60,000	.00205	.00020	.....	.....	
64,000	.00220	.00015	.....	.....	Elastic limit.
65,000	.00250	.00030	.....	.....	
66,000	.00925	.00675	.....	.....	
67,000	.01095	.00170	.....	.....	
68,000	.01280	.00185	.....	.....	
104,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,000
Elastic limit per square inch of original section	do...	64,000
Elongation per inch after rupture	inch..	.225
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		".90 from the neck
Character of broken surface		silky
Elongation of inch sections		".15, ".30*

TUBE.

No. 8069.

Marks, $\frac{42896\ B_1}{BT_4M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00095	.00070	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00160	.00035	0.	0.	
55,000	.00185	.00025	.....	.....	
59,000	.00200	.00015	.....	.....	
60,000	.00205	.00005	.....	.....	Elastic limit.
61,000	.00720	.00515	.....	.....	
62,000	.00925	.00205	.....	.....	
63,000	.01070	.00145	.....	.....	
95,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	95,000
Elastic limit per square inch of original section	do...	60,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.075
Reduction in area after rupture, per cent of original section		27.4
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		".22", ".16

TUBE.

No. 8085.

Marks, $\frac{45061\ B_2}{BT,M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00080	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
40,000	.00185	.00085	.....	.....	
50,000	.00170	.00085	0.	0.	
55,000	.00190	.00020	.....	.....	
60,000	.00205	.00015	.....	.....	
64,000	.00225	.00020	.....	.....	
65,000	.00280	.00005	.....	.....	Elastic limit.
66,000	.00575	.00845	.....	.....	
67,000	.00970	.00395	.....	.....	
68,000	.01075	.00105	.....	.....	
99,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds...	99,500
Elastic limit per square inch of original section	do...	65,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	.00230
Reduction in diameter at point of rupture	do...	.090
Reduction in area after rupture, per cent of original section		35
Position of rupture		".90 from the nec 4
Character of broken surface		silkk
Elongation of inch sections		".14, ".24y

TUBE.

No. 8106.

Marks, $\frac{49504\ B_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00080	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
40,000	.00135	.00035	.....	.....	
50,000	.00175	.00040	0.	0.	
55,000	.00185	.00010	.....	.....	
60,000	.00210	.00025	.....	.....	
63,000	.00215	.00005	.....	.....	
64,000	.00225	.00010	.....	.....	Elastic limit.
65,000	.00350	.00125	.....	.....	
66,000	.00925	.00575	.....	.....	
67,000	.01100	.00175	.....	.....	
97,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	97,500
Elastic limit per square inch of original section	do...	64,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00225
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		".95 from the neck
Character of broken surface		silky, oblique, serrated
Elongation of inch sections		".14, ".28*

TUBE.

No. 8108.

Marks, $\frac{50624\ B_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
20,000	.00065	.00035	.....	.....	
30,000	.00100	.00035	.....	.....	
50,000	.00170	.00070	0.	0.	
60,000	.00200	.00030	.....	.....	
63,000	.00210	.00010	.....	.....	
63,500	.....	.....	.....	.....	Elastic limit.
64,000	.01280	.01070	.....	.....	
65,000	.01310	.00030	.....	.....	
66,000	.01370	.00060	.....	.....	
94,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	94,000
Elastic limit per square inch of original section	do...	63,500
Elongation per inch after rupture	inch..	.115
Reduction in diameter at point of rupture	do...	.045
Reduction in area after rupture, per cent of original section		16.9
Position of rupture		".55 from the neck
Character of broken surface		silky, serrated; opened numerous minute cracks in surface of stem
Elongation of inch sections		".14[a], ".09

JACKET.

No. 8004.

Marks, $\frac{42206\ B_2}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00095	.00070	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00150	.00025	0.	0.	
60,000	.00195	.00045	.....	.....	
65,000	.00220	.00025	.....	.....	Elastic limit.
66,000	.00810	.00090	.....	.....	
67,000	.00820	.00810	.....	.....	
68,000	.00780	.00160	.....	.....	
100,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	100,500
Elastic limit per square inch of original section	do...	65,000
Elongation per inch after rupture	inch..	.115
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.045
Reduction in area after rupture, per cent of original section		16.9
Position of rupture		".55 from the neck
Character of broken surface		silky and granular metal interspersed; oblique
Elongation of inch sections		".14*, ".09

JACKET.

No. 8005.

Marks, $\frac{42133\ B_3}{BT_cM}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	.....	.....	
30,000	.00080	.00060	.....	.....	
40,000	.00110	.00030	.....	.....	
50,000	.00150	.00040	0.	0.	
55,000	.00170	.00020	.....	.....	
60,000	.00185	.00015	.....	.....	
65,000	.00200	.00015	.....	.....	
70,000	.00220	.00020	.....	.....	
72,000	.00225	.00005	.....	.....	Elastic limit.
73,000	.01585	.01310	.....	.....	
74,000	.01655	.00120	.....	.....	
75,000	.01780	.00125	.....	.....	
101,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	101,500
Elastic limit per square inch of original section	do...	72,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00225
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.8
Position of rupture		at the middle of the stem
Character of broken surface		fine silky
Elongation of inch sections		".22*, ".20*

JACKET.

No. 8007.

Marks, $\frac{6RF\ 30J}{MT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00080	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
40,000	.00140	.00040	.....	.....	
50,000	.00175	.00035	0.	0.	
55,000	.00190	.00015	.....	.....	
60,000	.00200	.00010	.....	.....	
65,000	.00220	.00020	.....	.....	
70,000	.00245	.00025	.....	.....	
73,000	.00255	.00010	.....	.....	Elastic limit.
74,000	.00275	.00020	.....	.....	
75,000	.00345	.00070	.....	.....	
76,000	.00405	.00060	.....	.....	
114,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,500
Elastic limit per square inch of original section	do...	73,000
Elongation per inch after rupture	inch..	.195
Elongation per inch under strain at elastic limit	do...	.00255
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		87.1
Position of rupture		".75 from the neck
Character of broken surface		silky
Elongation of inch sections		".14, ".25*

JACKET.

No. 8009.

Marks, $\overset{6RF\ 82J}{BT_1O}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00080	.00015	.....	.....	
30,000	.00095	.00065	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00160	.00035	0.	0.	
55,000	.00175	.00015	.....	.....	
60,000	.00195	.00020	.....	.....	
65,000	.00215	.00020	.....	.....	Elastic limit.
	.01180	.00965	.....	.....	
66,000	.01245	.00065	.....	.....	
67,000	.01385	.00140	.....	.....	
68,000	.01550	.00165	.....	.....	
95,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	95,000
Elastic limit per square inch of original section	do...	65,000
Elongation per inch after rupture	inch..	.215
Elongation per inch under strain at elastic limit	do...	.00215
Reduction in diameter at point of rupture	do...	.145
Reduction in area after rupture, per cent of original section		49.1
Position of rupture		″.7 from the neck
Character of broken surface		fine silky
Elongation of inch sections		″.31*, ″.12

JACKET.

No. 8010.

Marks, $\frac{6RF\ 33J}{MT,I}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00095	.00070	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00160	.00035	0.	0.	
55,000	.00180	.00020	.....	.....	
60,000	.00200	.00020	.....	.....	
65,000	.00220	.00020	.....	.....	
68,000	.00245	.00025	.....	.....	Elastic limit.
69,000	.00255	.00010	.....	.....	
70,000	.00540	.00285	.....	.....	
71,000	.00680	.00140	.....	.....	
72,000	.00820	.00140	.....	.....	
104,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,500
Elastic limit per square inch of original section	do...	68,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00245
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		".12, ".28*

JACKET.

No. 8013.

Marks, $\frac{42071\ B_2}{BT,M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00080	.00015	.....	.....	
30,000	.00095	.00065	.....	.....	
40,000	.00135	.00040	.....	.....	
50,000	.00165	.00030	0.	0.	
60,000	.00200	.00035	.....	.....	
65,000	.00215	.00015	.....	.....	
68,000	.00225	.00010	.....	.....	Elastic limit.
69,000	.00300	.00075	.....	.....	
	.01000	.00700	.....	.....	
70,000	.01090	.00090	.....	.....	
71,000	.01280	.00190	.....	.....	
103,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	103,000
Elastic limit per square inch of original section	do...	68,000
Elongation per inch after rupture	inch..	.170
Elongation per inch under strain at elastic limit	do...	.00225
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		".8 from the neck
Character of broken surface		silky, oblique
Elongation of inch sections		".28", ".11

JACKET.

No. 8100.

Marks, $\frac{47450\ B_1}{BT,\ M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00080	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
40,000	.00130	.00080	.....	.....	
50,000	.00170	.00040	0.	0.	
55,000	.00180	.00010	.....	.....	
60,000	.00200	.00020	.....	.....	
65,000	.00220	.00020	.....	.....	
67,000	.00225	.00005	.....	.....	Elastic limit.
68,000	.00290	.00065	.....	.....	
69,000	.00600	.00310	.....	.....	
70,000	.01075	.00475	.....	.....	
105,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	105,000
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00225
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		84
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		".28*, ".14

JACKET.

No. 8102.

Marks, $\frac{40240\ B_2}{BT_cM}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
30,000	.00095	.00065	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00155	.00030	0.	0.	
55,000	.00180	.00025	.....	.....	
60,000	.00200	.00020	.....	.....	
65,000	.00225	.00025	.....	.....	
69,000	.00255	.00030	.....	.....	Elastic limit.
70,000	.00825	.00570	.....	.....	
71,000	.01000	.00175	.....	.....	
72,000	.01100	.00100	.....	.....	
106,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	106,000
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00255
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		48.3
Position of rupture		1".10 from the neck
Character of broken surface		silky
Elongation of inch sections		".21", ".19

BREECHBLOCK.

No. 8006.

Marks, $\frac{43116\ B_2}{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00085	.00060	.....	.....	
50,000	.00155	.00070	0.	0.	
55,000	.00175	.00020	.....	.....	
60,000	.00195	.00020	.....	.....	
65,000	.00215	.00020	.....	.....	
70,000	.00235	.00020	.....	.....	
75,000	.00260	.00025	.....	.....	
77,000	.00275	.00015	.....	.....	Elastic limit.
78,000	.00360	.00085	.....	.....	
79,000	.00475	.00115	.....	.....	
80,000	.00555	.00080	.....	.....	
125,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	125,500
Elastic limit per square inch of original section	do...	77,000
Elongation per inch after rupture	inch..	.170
Elongation per inch under strain at elastic limit	do...	.00275
Reduction in diameter at point of rupture	do...	.096
Reduction in area after rupture, per cent of original section		34
Position of rupture		1".05 from the neck
Character of broken surface		silky
Elongation of inch sections		".19*, ".15

BREECHBLOCK.

No. 8073.

From forging S 8390.
Marks, $\frac{6RF_9BB}{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00080	.00080	0.	0.	
30,000	.00105	.00075	.....	.....	
50,000	.00175	.00070	0.	0.	
55,000	.00195	.00020	.....	.....	
60,000	.00205	.00010	.....	.....	
65,000	.00230	.00025	.....	.....	
66,000	.00240	.00010	.....	.....	
67,000	.00245	.00005	.....	.....	Elastic limit.
68,000	.00290	.00045	.....	.....	
69,000	.00815	.00525	.....	.....	
70,000	.00925	.00110	.....	.....	
71,000	.01025	.00100	.....	.....	
106,000	.....	.....	.....	.....	Tensile strength.

General Summary.

Tensile strength per square inch of original section	pounds..	106,000
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00245
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		1".15 from the neck
Character of broken surface		silky
Elongation of inch sections		".18, ".22

BREECHBLOCK.

No. 8074.

Forging S 8515.
Marks, $\frac{6\,RF_{40}BB}{T_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
30,000	.00105	.00095	.....	.....	
50,000	.00185	.00080	.00005	.00005	
55,000	.00195	.00010	.....	.....	
60,000	.00210	.00015	.....	.....	
65,000	.00230	.00020	.....	.....	
70,000	.00250	.00020	.....	.....	
72,000	.00260	.00010	.....	.....	Elastic limit.
73,000	.01000	.00740	.....	.....	
74,000	.01050	.00050	.....	.....	
75,000	.01130	.00080	.....	.....	
109,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	109,500
Elastic limit per square inch of original section	do...	72,000
Elongation per inch after rupture	inch..	.175
Elongation per inch under strain at elastic limit	do...	.00260
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		at the middle of the stem
Character of broken surface		silky
Elongation of inch sections		".14, ".21*

TABULATION OF TENSION SPECIMENS FROM 6-INCH R. F. GUNS.

STEMS 2" LONG, ".505 DIAMETER,

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
8008	Tube....	Middle..	67,000	109,500	20.5	51.9	Silky.....	Muzzle end.
8011	....do...	....do...	63,000	95,500	23.5	49.1	.....do.....	Breech end.
8012	....do...	....do...	64,000	104,000	22.5	46.2	.....do.....	Do.
8089	....do...	....do...	60,000	95,000	19.0	27.4	.....do.....	Do.
8085	....do...	....do...	65,000	99,500	19.0	34.0	.....do.....	Do.
8106	....do...	....do...	64,000	97,500	18.5	30.7	Silky, serrated	Do.
8108	....do...	....do...	63,500	94,000	11.5	16.9	.....do.....	Do.
8004	Jacket ..	....do...	65,000	100,500	11.5	16.9	Silky and granular metal interspersed.	Do.
8005	....do...	....do...	72,000	101,500	21.0	40.3	Silky.....	Do.
8007	....do...	....do...	73,000	114,500	19.5	37.1	.....do.....	Muzzle end.
8009	....do...	Outside .	65,000	95,000	21.5	49.1	.....do.....	Breech end.
8010	....do...	Inside ..	68,000	104,500	20.0	46.2	.....do.....	Muzzle end.
8013	....do...	Middle..	68,000	103,000	17.0	30.7	.....do.....	Breech end.
8100	....do...	....do...	67,000	105,000	18.5	34.0	.....do.....	Do.
8102	....do...	....do...	69,000	106,000	20.0	43.3	.....do.....	Do.
8006	Breech-block.	....do...	77,000	125,500	17.0	34.0	.....do.....	
8073	....do...	....do...	67,000	106,000	20.0	34.0	.....do.....	
8074	....do...	....do...	72,000	109,500	17.5	37.1	.....do.....	

12-INCH STEEL B. L. MORTARS.

SPECIMENS FROM TUBE AND JACKET.

TUBE.

No. 8076.

Marks, $\frac{12MR_4T}{BT_4I}$
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000288	.000188	.....	.....	
30,000	.000833	.000600	.....	.....	
40,000	.001133	.000300	.....	.....	
44,000	.001267	.000134	0.	0.	
45,000	.001300	.000033	.....	.....	
50,000	.001467	.000167	.....	.....	
53,000	.001667	.000200	.....	.....	
54,000	.001667	0.	.....	.....	Elastic limit.
55,000	.001867	.000200	.....	.....	
56,000	.002333	.000466	.....	.....	
57,000	.003233	.000900	.....	.....	
58,000	.004567	.001334	.....	.....	
98,200	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	98,200
Elastic limit per square inch of original section	do...	54,000
Elongation per inch after rupture	inch..	.198
Elongation per inch under strain at elastic limit	do...	.001667
Reduction in diameter at point of rupture	do...	.154
Reduction in area after rupture, per cent of original section		47.2
Position of rupture		1″.35 from the neck
Character of broken surface		silky
Elongation of inch sections		″.18, ″.29, ″.11

JACKET.

No. 8075.

Marks, $\frac{12MR_2J}{BT_1M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000200	.000200	0.	0.	
10,000	.000333	.000133	.....	.....	
30,000	.001133	.000800	.....	.....	
40,000	.001567	.000434	.000100	.000100	
44,000	.001700	.000133	.000167	.000067	
45,000	.001767	.000067	.....	.....	
46,000	.001833	.000066	.....	.....	Elastic limit.
47,000	.001967	.000134	.....	.....	
48,000	.002233	.000266	.....	.....	
49,000	.002567	.000334	.....	.....	
50,000	.003833	.001266	.....	.....	
90,800	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	90,800
Elastic limit per square inch of original section	do...	46,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.001833
Reduction in diameter at point of rupture	do...	.134
Reduction in area after rupture, per cent of original section		41.9
Position of rupture		".75 from the neck
Character of broken surface		silky, trace of granulation
Elongation of inch sections		".12, ".13, ".35*

STEEL CASTINGS FOR GUN CARRIAGE WORK.

STEEL CASTINGS FOR GUN CARRIAGE WORK.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
71	.29	.72	.270	.042	.043	48,500	87,000	26.0	37.1	.18, .34*	Silky; oblique.
72	.30	.73	.285	.045	.043	47,000	90,000	18.0	27.4	.14, .22*	Granular; in part silky.
73	.25	.70	.280	.046	.042	43,500	84,500	25.5	46.2	.30*, .21	Silky.
						45,500	89,500	21.5	40.3	.30*, .13	Do.
						32,500	72,000	18.0	20.5	.16, .20*	Irregular; amorphous.
						34,000	72,500	19.5	23.9	.23*, .16	Dull silky; opened cracks in stem.
74	.30	.80	.325	.065	.038	43,000	85,500	24.0	37.1	.29*, .19	Silky.
75	.26	.85	.282	.051	.038	47,000	84,500	26.0	43.3	.19, .33*	Do.
						46,000	84,500	26.0	46.2	.25*, .27*	Do.
						45,500	84,500	23.0	37.1	.15, .31*	Do.
						46,000	84,500	25.5	46.2	.33*, .18	Do.
76	.32	.78	.263	.054	.040	44,000	84,000	20.0	30.7	.18, .22*	Silky; trace of granulation.
	.26	.80	.263	.054	.040	42,500	85,500	24.0	40.3	.18, .30*	Silky.
77	.30	.89	.263	.051	.044	52,500	96,000	21.5	34.0	.27, .16	Do.
78	.23	.60	.315	.046	.045	41,500	79,500	21.0	30.7	.20*, .22*	Do.
79	.30	.88	.320	.046	.044	46,000	95,500	10.0	13.2	.09, .11*	Granular; silky spot.
						47,500	94,500	8.5	13.2	.09*, .08	Medium granular; silky spot.
						31,000	68,500	26.0	34.0	.31*, .21	Silky.
80	.37	.95	.430	.036	.043	(a)					
81	.48	.96	.237	.036	.044	(a)					
82	.30	.74	.48	.033	.043	42,000	86,000	21.5	34.0	.17, .26*	Do.
83	.26	.93	.200	.036	.040	43,000	94,500	22.5	37.1	.20, .25*	Do.
84	.35	.74	.208	.042	.038	33,500	72,000	30.0	49.1	.22, .38*	Do.
						39,290	76,580	32.0	51.0	.42*, .22	Do.
85	.46	.90	.387	.033	.041	28,000	64,500	13.5	20.5	.13, .14*	Silky; oblique; dark spot.
						33,000	69,000	25.5	40.3	.19, .32*	Silky.
						33,500	69,000	28.5	37.1	.26, .31*	Do.
86	.31	.80	.297	.046	.047	46,500	91,500	20.0	23.9	.24*, .16	Silky; in part granular.
87	.30	.81	.282	.043	.044	49,500	58,000	19.5	27.4	.22*, .17	Dull silky.
88	.30	.82	.291	.048	.045	47,000	84,500	18.5	27.4	.24*, .13	Silky.
89	.26	.80	.282	.042	.045	36,500	77,000	27.0	40.3	.17, .37*	Do.
90	.30	.81	.282	.046	.047	44,500	94,500	22.0	37.1	.28*, .16	Do.
91	1.89	.82	.169	.046	.044						
92	1.55	.82	.333	.043	.045						
93	1.63	.84	.453	.040	.045						

a See Forged steel from ingots cast at Watertown Arsenal.

STEEL CASTINGS FOR GUN CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
94	.30	.79	.300	.045	.043	41,500	84,000	25.0	40.3	.25*, .25*	Silky.
95	.30	.80	.272	.042	.043	46,000	88,500	20.5	37.1	.16, .25*	Do.
96	.24	.80	.283	.043	.044	38,000	78,000	19.0	23.9	.18, .25*	Do.
						42,000	79,500	18.5	20.5	.17, .20*	Do.
						42,500	80,500	20.5	27.4	.20*, .21*	Do.
						36,000	69,000	30.0	46.2	.31*, .29*	Do.
						34,500	69,000	29.0	46.2	.37*, .21	Do.
97	.30	.80	.304	.047	.043	36,500	74,500	19.5	20.5	.23*, .16	Silky; trace of granulation.
98	.25	.82	.282	.042	.049	41,000	81,000	20.5	30.7	.17, .24*	Silky.
						31,500	73,500	24.0	37.1	.17, .31*	Do.
						33,000	73,000	24.0	30.7	.25*, .23	Do.
						35,500	72,500	24.5	30.7	.19, .30*	Do.
						32,500	72,000	23.0	34.0	.23*, .23	Do.
						33,500	71,000	23.5	34.0	.27*, .20	Do.
						34,000	69,500	18.0	20.5	.15, .21*	Do.
						35,500	74,000	26.5	37.1	.27*, .26*	Do.
						36,500	73,000	22.5	30.7	.19, .26*	Silky; trace of granulation.
						36,500	70,500	23.0	27.4	.20, .26*	Do.
99	.31	.84	.270	.043	.047	42,500	67,500	4.5	13.2	.06, .04	Dull silky; bright spot.
						41,000	83,500	11.5	18.2	.12*, .11	Granular; opened cracks in stem.
						35,000	70,500	25.0	37.1	.27*, .23	Silky.
						39,000	76,000	29.0	51.9	.38*, .20	Do.
						43,500	85,500	20.5	27.4	.18, .23*	Do.
100	.32	.78	.300	.037	.052						
101	.32	.77	.280	.043	.052	42,500	88,000	20.5	30.7	.17, .24*	Granular; in part silky.
102	.33	.79	.285	.037	.052	41,500	78,500	12.5	20.5	.14*, .11	Dull silky; opened cracks in stem.
						36,000	69,500	29.5	49.1	.23, .36*	Silky.
						45,500	94,000	16.0	23.9	.11, .21*	Silky, 60 per cent; granular, 40 per cent.
						41,000	82,500	21.5	27.4	.23*, .20*	Silky.
						45,500	84,500	14.0	16.9	.13, .15*	Granular, 50 per cent; silky, 50 per cent.
						43,500	80,000	24.0	37.1	.31*, .17	Silky.
103	.24	.84	.262	.054	.044	33,000	69,500	30.0	49.1	.37*, .23	Do.
						33,000	69,500	30.0	49.1	.29*, .31*	Do.
						32,500	67,500	30.5	49.1	.26, .35*	Fine silky.
104	.34	.93	.490	.051	.045	44,500	87,500	14.5	16.9	.13, .16*	Granular, 60 per cent; silky, 40 per cent.
						51,000	99,000	14.0	16.9	.14*, .14	Granular; silky spot.
						47,500	92,500	17.5	20.5	.16, .19*	Do.

						43,500	84,500	16.5	20.5	.19*, .14	Silky; in part granular.
						47,000	88,000	14.5	16.9	.14, .15*	Granular, 60 per cent; silky, 40 per cent.
						46,500	88,500	16.0	20.5	.19*, .13	Dull silky.
105	.33	.86	.300	.046	.044	45,500	82,000	7.0	13.2	.06, .08*	Granular and dull silky; opened cracks in stem.
						43,000	98,500	17.5	20.5	.20*, .15*	Granular; silky spot.
						43,000	73,000	4.0	.....	.04, .04	Dull amorphous; spongy.
						43,000	88,000	15.0	20.5	.18*, .12	Granular, 60 per cent; silky, 40 per cent.
106	.24	.83	.285	.046	.044	37,500	76,500	18.5	20.5	.20*, .17	Granular, 40 per cent; silky, 60 per cent.
						37,000	73,000	19.0	20.5	.20*, .18	Granular, 50 per cent; dull silky, 50 per cent.
						39,500	71,000	15.5	23.9	.21*, .10	Silky; trace of granulation
						36,000	61,000	6.0	13.2	.09*, .03	Dull; amorphous.
						36,000	69,500	23.0	27.4	.25*, .21	Silky.
						37,500	72,500	11.5	13.2	.13*, .10*	Dull silky; opened cracks in stem.
						34,000	68,000	23.0	27.4	.19, .27*	Silky.
107	.28	1.00	.262	.035	.044	45,500	84,000	11.0	13.2	.14, .08*	Silky; trace of granulation.
						42,000	88,000	17.0	20.5	.16, .18*	Silky.
108	.23	.82	.242	.045	.045	37,500	72,500	26.0	40.3	.34*, .18	Do.
						34,500	72,500	29.5	43.3	.24, .35*	Do.
						33,500	69,500	28.0	43.3	.20, .36*	Do.
						35,500	69,500	29.5	43.3	.21, .38*	Do.
109	.33	.82	.250	.035	.045	43,000	98,000	16.5	20.5	.15, .18*	Granular, 60 per cent; silky, 40 per cent.
110	.33	.93	.283	.035	.045	42,000	79,500	13.5	16.9	.16*, .11	Granular, 50 per cent; silky, 50 per cent.
						46,000	76,000	9.0	16.9	.07, .11*	Silky.
						36,000	68,000	20.0	20.5	.19, .21*	Dull silky; irregular.
						38,500	78,500	15.0	16.9	.15*, .15	Do.
						37,500	73,500	8.5	13.2	.10*, .07	Do.
						40,500	76,500	12.5	16.9	.14*, .11	Silky, 60 per cent; granular, 40 per cent.
						35,000	72,500	16.0	20.5	.16, .16*	Granular, 60 per cent; silky, 40 per cent.
						33,500	69,000	24.0	27.4	.20, .28*	Silky.
						36,000	72,000	18.5	20.5	.22*, .16	Gray; vesicular.
						36,500	72,500	19.5	23.9	.18, .21*	Do.
111	.39	.89	.244	.055	.043	(a)	.....	.....	.....	.....	.....
112	.24	.89	.200	.053	.043	32,000	67,000	21.5	23.9	.20, .23*	Silky.
						37,500	68,000	20.0	20.5	.22*, .18	Do.
						36,000	64,500	15.0	16.9	.15, .15*	Do.
						40,500	88,000	19.5	27.4	.22*, .17	Silky, 40 per cent; granular, 60 per cent.
113	.29	.82	.210	.050	.042	38,500	74,000	10.5	13.2	.09, .12*	Granular, 60 per cent; silky, 40 per cent.
						38,500	74,500	12.5	13.2	.09, .16*	Dull silky; trace of granulation.
						41,000	89,000	21.0	27.4	.25*, .17	Silky.
114	.35	.83	.400	.040	.046	46,500	103,500	10.0	13.2	.08, .12*	Granular.
						50,500	100,500	22.5	34.0	.26*, .19	Silky.
115	.24	.81	.210	.043	.043	31,000	68,000	26.0	30.7	.25*, .27*	Do.
						28,000	64,500	26.0	30.7	.19, .33*	Do.
116	.35	.82	.385	.042	.045	49,000	94,000	19.0	23.9	.20*, .18*	Granular, 60 per cent; silky, 40 per cent.
117	.23	.88	.300	.042	.040	40,500	82,000	26.0	37.1	.33*, .19	Silky.
						42,500	84,500	23.5	40.3	.30*, .17	Do.
						41,500	84,000	23.0	37.1	.19, .27*	Do.
118	.34	.89	.323	.035	.049	41,000	88,000	20.0	20.5	.22*, .18	Granular, 85 per cent; silky, 15 per cent.
119	.37	.77	.285	.040	.048	.....	.....	.....	.....	.....	.....
120	.25	.79	.268	.035	.048	37,500	66,000	5.0	9.5	.04, .06*	Silky; in part granular.

a See Forged steel from ingots cast at Watertown Arsenal.

STEEL CASTINGS FOR GUN CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	" "	
120	.25	.79	.268	.035	.048	32,500	73,000	17.5	28.9	.19*, .16	Silky.
						37,500	80,500	24.0	37.1	.18, .20*	Do.
121	.25	.83	.270	.058	.047	44,500	79,000	23.5	34.0	.18, .29*	Do.
						33,000	72,000	20.5	27.4	.23*, .18	Do.
						31,000	67,000	24.0	18.2	.19, .29*	Silky; trace of granulation.
122	.36	.82	.321	.030	.042	(a)					
123	.36	.82	.328	.030	.043	(a)					
124	.37	.82	.308	.039	.043	44,000	90,500	19.5	27.4	.17, .22*	Granular; in part silky.
125	.25	.80	.321	.042	.....	38,000	77,000	22.0	20.5	.25*, .19	Dull silky; irregular.
						39,000	70,500	17.5	13.2	.15, .20*	Do.
						48,730	84,260	24.5	29.9	.18, .31*	Silky; trace of granulation.
						35,000	72,500	19.0	20.5	.16, .22*	Dull silky; irregular.
						37,500	79,500	25.5	34.0	.20, .31*	Silky; trace of granulation.
						42,000	82,500	18.0	20.5	.19*, .07	Do.
126	.24	.86	.270	.065	.045	45,000	83,500	24.0	37.1	.28*, .20	Silky.
						42,000	82,500	24.0	34.0	.28*, .20	Do.
127	.24	.82	.249	.046	.045	35,500	70,000	28.0	43.3	.23, .33*	Do.
128	.32	.86	.327	.058	.044	(a)					
129	.32	.86	.327	.058	.044						
130	.30	.76	.300	.060	.050	38,500	55,500	2.5	5.7	.03*, .02	Dull silky, 60 per cent; granular, 40 per cent.
131	.25	.81	.263	.070	.045	41,000	75,500	27.0	46.2	.20, .34*	Silky.
						43,500	75,000	26.0	37.1	.30*, .22	Do.
						42,000	75,000	27.0	43.3	.32*, .22	Do.
						38,000	68,500	10.0	9.5	.08, .12*	Dull silky; irregular.
						44,500	79,500	25.5	37.1	.32*, .19	Silky; trace of granulation.
						39,500	72,000	18.0	20.5	.20*, .16	Dull silky; irregular.
132	.26	.81	.219	.070	.045	40,500	79,000	26.0	40.3	.28*, .24	Silky.
133	.30	.84	.....	.039	.040	59,500	104,500	16.0	23.9	.20*, .12	Silky, 20 per cent; granular, 80 per cent.
134	.27	.85	.....	.040	.041						
135	.34	.84	.381	.055	.041	53,500	96,500	17.6	20.5	.21*, .14	Fine granular.
						54,000	97,000	17.0	20.5	.13, .21*	Do.
136	.30	.81	.351	.046	.040						
137	.24	.79	.344	.048	.041	52,500	87,500	23.5	43.3	.15, .32*	Silky.
						48,000	81,000	20.0	37.1	.29*, .11	Do.
138	.36	.62	.330	.040	.046	(a)					
139	.25	.79	.340	.039	.040	54,000	90,000	24.0	40.3	.23*, .25*	Do.
140	.31	.84	.347	.050	.043						

141	.25	.84	.342	.034	.041	51,520	89,900	19.0	19.7	.16, .22*	Granular.
142	.29	.85	.333	.034	.040	55,500	93,500	20.5	27.4	.21*, .20*	Fine granular.
						51,500	86,600	16.0	20.5	.15, .17*	Dull silky, 80 per cent; fine granular, 20 per cent.
143	.25	.83	.338	.049	.040	51,500	89,000	24.5	37.1	.29*, .20	Silky.
						54,000	89,000	20.0	37.1	.28*, .12	Do.
144	.24	.83	.314	.033	.042	50,500	82,500	23.5	37.1	.27*, .20	Silky; trace of granulation.
						53,000	91,500	17.0	23.9	.12, .22*	Fine granular; silky spot.
145	.25	.83	.295	.036	.042	49,500	84,000	23.5	37.1	.18, .29*	Silky; trace of granulation.
146	.25	.84	.297	.042	.042	51,500	88,000	24.5	40.3	.26*, .23	Silky.
						49,500	86,500	24.0	43.3	.28*, .20	Silky; trace of granulation.
						50,000	86,000	22.5	37.1	.29*, .16	Do.
						48,500	84,000	23.5	40.3	.17, .30*	Silky.
						48,500	86,500	25.0	43.3	.19, .31*	Do.
147	.31	.52	.262	.046	.042	52,500	75,500	3.0	1.8	.04, .02	Granular.
						51,000	92,000	19.5	27.4	.18, .21*	Fine granular, 70 per cent; silky, 30 per cent.
						51,520	89,390	14.0	16.2	.16*, .12	Granular, 50 per cent; silky, 50 per cent.
						46,500	65,500	8.5	5.7	.02, .05*	Granular, spongy.
						51,500	91,000	20.5	30.7	.20*, .21*	Fine granular, 30 per cent; silky, 70 per cent.
148	.25	.84	.339	.043	.040	31,500	67,000	26.5	30.7	.29*, .24*	Dull silky.
						53,000	89,500	22.5	34.0	.25*, .20	Silky; trace of granulation.
						53,000	82,500	24.0	37.1	.27*, .21	Silky.
149	.25	.85	.348	.045	.040	56,000	85,500	23.0	43.3	.18, .25*	Do.
						50,000	88,000	14.0	13.2	.15*, .13	Granular, 70 per cent; silky, 30 per cent.
						54,500	85,500	16.5	20.5	.19*, .14	Silky, 40 per cent; granular, 60 per cent.
150	.30	.81	.....	.055	.042	56,500	93,500	13.5	13.2	.13, .14*	Fine granular; gray spot.
						58,500	95,500	13.5	13.2	.13, .14*	Granular; silky spot.
						51,500	103,500	18.0	30.7	.18*, .18*	Silky; trace of granulation.
						61,500	105,000	12.5	20.5	.18, .07	Fine granular.
						50,500	86,000	14.0	16.9	.16*, .12	Dull silky, 70 per cent; granular, 30 per cent.
						50,000	87,500	19.5	27.4	.20*, .19	Fine granular, 50 per cent; silky, 50 per cent.
151	.30	.79	.342	.046	.035	51,500	83,500	15.5	13.2	.17*, .14	Granular, 60 per cent; silky, 40 per cent.
						53,000	89,000	17.5	20.5	.20*, .15	Fine granular, 60 per cent; silky, 40 per cent.
152	.29	.81	.321	.054	.035	54,000	89,500	21.5	34.0	.20, .23*	Fine granular, 70 per cent; silky, 30 per cent.
						54,000	89,500	20.0	23.9	.23*, .17	Fine granular, 80 per cent; silky, 20 per cent.
153	.25	.89	.303	.048	.035	54,500	89,500	18.5	30.7	.11, .26*	Silky.
154	.30	.81	.290	.037	.038	51,500	88,000	22.0	34.0	.24, .20	Do.
155	.25	.79	.277	.046	.038	52,500	87,000	22.5	40.3	.29*, .16	Do.
156	.24	.82	.266	.058	.038	52,000	87,000	22.5	37.1	.25*, .19	Silky; trace of granulation.
						53,500	88,000	22.5	40.3	.14, .31*	Silky.
						53,000	87,500	21.0	34.0	.26*, .16	Silky; trace of granulation.
						50,000	80,500	24.0	37.1	.30*, .18	Silky.
157	.30	.85	.319	.040	.043	54,500	94,500	17.5	23.9	.19*, .16*	Silky, 15 per cent; fine granular, 85 per cent.
158	.29	.55	.320	.045	.042	58,000	105,500	17.5	27.4	.23*, .12	Silky, 60 per cent; gray, 40 per cent.
B158	.30	.72	.270	.045	.043	51,500	84,000	8.5	5.7	.09*, .08	Granular; blowhole.
159	.25	.81	.....	.045	.043	54,000	83,500	23.5	37.1	.23*, .19	Silky.
160	.25	.96	.283	.056	.043	56,500	94,000	22.5	37.1	.18, .27*	Do.
161	.23	.82	.390	.046	.045	51,000	86,000	23.5	43.3	.17, .30*	Do.
						53,000	85,000	22.0	43.3	.19, .25*	Do.
						52,500	88,000	24.5	43.3	.27*, .22	Do.
						53,000	83,500	21.0	27.4	.21*, .21*	Silky; oblique.
162	.28	.84	.240	.077	.044	56,500	106,000	16.5	23.9	.11, .22*	Granular: in part silky.

[a] See Forged steel from ingots cast at Watertown Arsenal.

STEEL CASTINGS FOR GUN CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
162	.28	.84	.240	.077	.044	60,000	102,500	18.5	20.5	.18*, .19	Fine granular, 80 per cent; silky, 20 per cent.
163	.27	.90	.343	.057	.045	51,500	82,500	6.0	5.7	.05, .07*	Granular; flaky spot.
						51,000	91,000	22.0	37.1	.28*, .16	Silky.
164	.41	.95	.460	.086	.045	53,500	97,000	19.0	27.4	.22*, .16	Granular, 60 per cent; silky, 40 per cent.
						54,500	88,500	10.5	13.2	.11, .10*	Granular; silky spot.
						56,000	93,000	21.5	30.7	.22*, .21	Silky.
165	.27	.78	.277	.081	.048	50,500	87,500	21.5	34.0	.22*, .21*	Do.
166	.32	.74	.417	.093	.046						
167						51,000	83,000	26.0	40.3	.21, .31*	Do.
168	.29	.82	.330	.082	.038	56,000	93,500	16.0	20.5	.18*, .14	Granular; silky spot.
						59,500	88,500	21.0	27.4	.20, .22*	Granular; in part silky.
169	.29	.77	.216	.079	.039	53,000	86,500	23.0	37.1	.26*, .20*	Silky.
170	.24	.76	.270	.081	.038	53,500	83,000	25.0	43.3	.21, .29	Do.
						54,500	74,000	9.5	16.9	.13*, .05	Dull amorphous; black cavities.
						53,000	78,000	25.0	46.2	.32*, .18	Silky.
171	.29	.82	.276	.055	.040	62,500	104,000	5.0	5.7	.06*, .04	Granular.
B171	.23	.76	.276	.055	.040	52,000	78,500	21.5	34.0	.26*, .17	Silky.
						51,500	79,500	23.0	37.1	.22, .24*	Do.
						52,000	79,500	24.0	46.2	.25*, .23	Do.
172	.23	.76	.250	.070	.042	56,500	83,000	23.5	40.3	.25*, .22*	Do.
						60,500	94,000	21.0	37.1	.20*, .22*	Do.
173	.29	.83	.447	.055	.041	54,000	93,000	17.5	20.5	.19*, .16	Granular; silky spot.
174	.24	.78	.280	.075	.040	52,000	81,500	23.5	40.3	.19, .28*	Silky; oblique.
						51,000	79,000	24.5	40.3	.20, .29*	Silky.
						52,500	79,500	25.0	43.3	.29*, .21	Do.
						51,500	82,500	24.0	37.1	.19, .29*	Do.
175	.24	.76	.321	.074	.040	51,000	82,000	22.0	40.3	.27*, .17	Do.
176	.30	.76	.333	.051	.040	54,500	82,000	5.5	9.5	.07*, .04	Granular, 50 per cent; oblique, vesicular, 50 per cent.
						52,000	92,500	17.0	20.5	.18*, .16	Granular.
						52,500	88,500	12.5	13.2	.13*, .12	Granular, 70 per cent; silky, 30 per cent.
177	.31	.79	.207	.073	.041	48,000	88,000	21.0	34.0	.16, .26*	Silky; trace of granulation.
178	.26	.80	.297	.074	.040	51,500	87,500	21.5	37.1	.20, .23*	Silky.
						52,000	88,000	22.0	37.1	.25*, .19	Do.
						51,500	87,500	21.5	34.0	.18, .25*	Do.
						53,000	88,000	23.0	34.0	.28*, .18	Silky; trace of granulation.
						51,000	87,500	21.5	34.0	.20, .23*	Do.
						51,000	87,500	20.0	30.7	.22*, .18	Silky and granular.

						54,000	90,000	22.0	37.1	.15, .29*	Silky.
						54,000	90,000	21.5	37.1	.17, .26*	Silky; trace of granulation.
						53,500	89,000	22.0	37.1	.15, .29*	Silky.
B 178	.29	.80	.297	.074	.040	58,000	89,500	23.0	37.1	.21, .25*	Do.
179	.31	.62	.366	.052	.042	(a)					
180	.29	.81	.375	.066	.042	56,000	91,500	22.0	34.0	.20, .24*	Silky; trace of granulation.
						51,000	89,500	13.3	16.9	.14*, .13	Granular, 60 per cent; silky, 40 per cent
						52,000	89,500	10.0	13.2	.11*, .09	Granular; silky spot.
181	.30	.90	.294	.052	.040	54,500	99,000	16.0	16.9	.17*, .15	Do.
						54,000	91,000	12.5	13.2	.13*, .12	Do.
182	.24	.82	.340	.061	.039	47,000	79,500	13.0	16.9	.14*, .12	Granular, 60 per cent; serrated vesicular, 40 per cent.
						52,000	79,500	21.0	34.0	.25*, .17	Silky.
183	.31	.93	.340	.046	.038	51,000	89,000	15.5	16.9	.14, .17*	Granular, 50 per cent; silky, 50 per cent.
						49,000	79,000	12.5	13.2	.11, .14*	Granular, 60 per cent; silky, 40 per cent.
						49,000	90,500	15.0	16.9	.17*, .13	Silky, 20 per cent; granular, 80 per cent.
						46,500	87,500	21.0	34.0	.17, .25*	Silky; trace of granulation.
						53,000	99,500	15.5	16.9	.16*, .15	Granular; silky spot.
184	.29	.92	.281	.043	.038	51,000	88,500	15.0	16.9	.13, .17*	Granular, 60 per cent; silky, 40 per cent.
						45,500	82,500	26.5	46.2	.34*, .19	Silky.
B 184	.26	.91	.281	.043	.038	50,500	82,500	23.5	37.1	.29*, .18	Do.
185	.25	.77	.300	.058	.038	(a)					
186	.28	.79	.343	.055	.035	42,500	78,000	22.5	30.7	.28, .22*	Silky; oblique.
187	.26	.76	.169	.055	.035	54,500	87,000	11.5	13.2	.12*, .11	Granular; silky spot.
						41,000	73,000	26.5	43.3	.29*, .24	Silky.
188	.25	.77	.110	.057	.033	52,500	93,000	17.5	20.5	.14, .21*	Granular; silky spot.
189	.26	.76	.300	.043	.038	29,000	29,000	1.5	1.8	.03*, .06	Granular; oblique; defective.
						55,000	89,000	13.5	16.9	.12, .15*	Granular; silky spot.
						53,000	82,500	24.0	43.3	.22, .26*	Silky.
190	.25	.67	.188	.054	.038						
191	.25	.66	.218	.051	.040	49,500	82,000	8.5	9.5	.10*, .07	Granular, 80 per cent; silky, 20 per cent.
						51,000	72,500	24.0	40.3	.24*, .24*	Silky.
						41,500	64,500	17.0	30.7	.21*, .13	Silky; fractured at blowhole.
						42,000	58,000	7.5	20.5	.08, .07	Dull silky; trace of granulation.
						42,500	66,000	31.5	51.9	.21, .42*	Silky.
						41,500	69,500	32.0	51.9	.40*, .24	Do.
						47,000	72,500	23.5	37.1	.29*, .18	Do.
						49,500	83,000	12.5	13.2	.11, .14*	Granular, 70 per cent; silky, 30 per cent.
						49,000	88,000	10.0	13.2	.11*, .09	Granular; silky spot.
						56,000	81,500	6.5	5.7	.05, .08*	Silky, 60 per cent; granular, 40 per cent.
192	.27	.74	.320	.049	.045	42,000	76,500	24.5	34.0	.29*, .20	Silky; oblique.
193	.26	.71	.263	.053	.042	(a)					
194	.26	.70	.310	.053	.040	51,000	78,000	25.5	43.3	.26*, .25	Silky.
195	.26	.70	.188	.033	.040	38,500	70,500	29.5	46.2	.37*, .22	Do.
196	.25	.76	.470	.045	.040	53,000	81,500	23.0	40.3	.18, .28*	Do.
197	.27	.65	.321	.057	.045						
198	.27	.68	.396	.051	.043	(a)					
199	.27	.71	.218	.048	.038	(a)					
200	.27	.79	.235	.051	.038	42,000	79,000	25.0	40.3	.20, .30*	Do.
201	.28	.76	.267	.054	.043	(a)					
202	.28	.76	.267	.054	.043	(a)					

a See Forged steel from ingots cast at Watertown Arsenal.

STEEL CASTINGS FOR GUN CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
203	.27	.80	.396	.061	.043	42,500	82,000	25.5	40.3	.30*, .21	Silky.
						42,000	80,500	25.5	37.1	.23, .23*	Do.
204	.28	.81	.470	.064	.043	47,500	93,000	20.5	34.0	.16, .25*	Silky; trace of granulation.
205	.28	.82	.377	.052	.040	(a)					
206	.29	.81	.366	.051	.039	(a)					
207	.29	.82	.391	.049	.037	(a)					
208	.27	.79	.395	.055	.036	36,000	70,000	29.0	49.1	.26, .32*	Silky.
209	.28	.83	.432	.042	.037	(a)					
210	.29	.84	.478	.046	.035	49,500	95,500	19.5	27.4	.21*, .18*	Fine granular; silky spot.
211	.28	.84	.451	.048	.035	(a)					
212	.28	.80	.357	.054	.037	37,000	72,000	29.0	46.2	.28, .30*	Silky.
213	.29	.82	.404	.043	.037	37,000	73,500	28.5	46.2	.34*, .28	Do.
214	.28	.80	.305	.045	.035	33,000	73,500	27.5	43.3	.34*, .21	Do.
215	.30	.84	.470	.046	.037	45,500	94,500	19.0	27.4	.17, .21*	Granular; silky spot.
216	.30	.84	.480	.046	.038	43,000	87,500	22.5	30.7	.24*, .21	Silky; in part fine granular.
217	.27	.83	.340	.040	.042	38,500	83,500	22.0	30.7	.18, .26*	Silky; trace of granulation.
218	.28	.83	.357	.037	.044	32,500	72,500	21.0	27.4	.25*, .17	Do.
219	.27	.81	.347	.040	.044	35,500	73,500	26.5	46.2	.18, .35*	Silky.
220	.27	.83	.490	.042	.046	(a)					
221	.27	.80	.350	.036	.043	39,500	82,000	19.0	20.5	.20*, .18	Granular; silky spot.
222	.27	.84	.404	.051	.045	34,500	74,500	27.0	40.3	.20, .34*	Silky.
223	.27	.84	.394	.040	.046	42,000	84,500	18.5	20.5	.15, .22*	Silky; trace of granulation.
						35,500	76,000	23.0	30.7	.24*, .22*	Do.
						36,500	73,500	28.0	40.3	.23, .33*	Silky.
224	.28	.82	.488	.039	.043	42,500	89,000	18.5	27.4	.21*, .16	Granular, 50 per cent; silky, 50 per cent.
225	.30	.85	.280	.040	.038	34,000	73,000	26.5	40.3	.31*, .20	Silky.
						36,500	73,000	11.5	16.9	.10, .13*	Granular; flaky spot.
						52,000	90,000	15.0	34.0	.22*, .08	Silky.
226	.32	.86	.423	.042	.040	39,500	84,000	15.0	16.9	.16*, .14	Granular; silky spot.
						41,000	41,000				Defective.
						35,000	77,000	26.0	43.3	.27*, .25*	Silky.
						42,500	53,000				Fractured in head; defective.
227	.36	.82	.470	.042	.041	37,000	75,500	21.0	28.9	.20, .22*	Silky; irregular.
						33,500	72,500	20.0	27.4	.16, .24*	Silky; trace of granulation.
228	.32	.82	.423	.045	.041	43,500	90,500	17.5	20.5	.20*, .15	Granular, 50 per cent; silky, 50 per cent.
229	.30	.83	.319	.036	.040	40,310	90,820	17.0	18.9	.19*, .15	Granular, 60 per cent; silky, 40 per cent.
						37,000	74,500	26.0	37.1	.26*, .26*	Silky.

						34,000	74,500	24.5	37.1	.19, .30*	Do.
230	.32	.84	.395	.036	.040	41,500	90,500	19.5	28.9	.19, .20*	Granular; silky spot.
						40,000	76,000	25.0	40.3	.21, .29*	Silky.
231	.30	.81	.479	.043	.040	44,500	102,000	15.5	20.5	.17*, .14	Do.
232	.30	.88	.388	.037	.039						
233	.29	.88	.360	.045	.041	34,500	73,500	29.0	43.3	.21, .37*	Do.
234	.30	.79	.280	.043	.040	34,000	69,500	29.0	46.2	.20, .38*	Do.
						32,000	67,000	28.5	40.3	.34*, .23	Do.
						47,000	85,000	19.0	34.0	.11, .27*	Silky; irregular.
235	.31	.81	.404	.043	.040	34,000	71,500	28.5	43.3	.22, .35*	Silky.
						41,500	78,000	18.5	28.9	.15, .22*	Granular and silky.
						45,500	84,000	15.5	16.9	.14, .17*	Granular, 50 per cent; silky, 50 per cent.
						40,500	78,500	20.0	23.9	.18, .22*	Granular, 60 per cent; silky; 40 per cent.
236	.29	.79	.340	.044	.040	41,500	84,500	21.0	30.7	.19, .28*	Silky; trace of granulation.
237	.30	.79	.406	.042	.040	31,000	65,500	32.5	46.2	.33*, .32*	Silky.
238	.29	.80	.356	.042	.040	40,000	79,000	21.5	27.4	.19, .24*	Silky; oblique.
239	.29	.79	.268	.045	.040	31,000	69,500	28.0	40.3	.22, .34*	Silky.
						56,500	92,000	14.0	23.9	.17*, .11	Dull silky; irregular.
						52,000	87,500	13.0	20.5	.12*, .14*	Silky; irregular.
						50,500	84,500	13.5	23.9	.17*, .10	Do.
						41,500	77,000	26.0	43.3	.34*, .18	Silky.
240	.29	.83	.281	.038	.042	37,000	73,500	25.0	34.0	.18, .32*	Silky; irregular.
241	.30	.88	.319	.037	.042	33,500	72,500	29.0	40.3	.32*, .26	Silky.
242	.29	.81	.329	.044	.040						
243	.29	.83	.293	.042	.040	(a)					
244	.28	.80	.319	.043	.041	41,500	67,000	9.5	20.5	.12*, .07	Dull gray; amorphous.
						44,000	71,000	14.0	20.5	.15*, .18	Do.
						42,000	68,000	8.5	16.9	.05, .12*	Do.
						44,000	79,500	24.0	30.7	.24*, .24*	Silky.
245	.28	.87	.385	.041	.045	(a)					
246	.28	.90	.423	.047	.045						
247	.29	.90	.347	.036	.043	45,500	80,500	23.5	30.7	.25*, .22	Do.
						33,000	71,000	30.0	46.2	.22 , .38*	Do.
						46,500	82,500	26.0	43.3	.34*, .18	Do.
248	.28	.86	.330	.040	.045	45,500	88,000	24.0	30.7	.21, .27*	Do.
						34,000	75,000	27.5	40.3	.33*, .22	Do.
249	.27	.84	.141	.043	.045	35,500	78,500	25.5	40.3	.25*, .26*	Do.
250	.29	.87	.460	.034	.045	37,500	71,500	30.5	46.2	.36*, .25	Do.
						56,000	89,000	18.0	27.4	.14, .22*	Silky; oblique; spotted.
251	.28	.82	.326	.035	.042	48,500	79,500	26.0	37.1	.22, .30*	Silky.
						38,000	72,000	29.0	43.3	.35*, .23	Do.
						44,500	81,500	25.0	37.1	.20*, .20	Silky; oblique.
252	.28	.86	.371	.035	.042	35,000	73,500	26.5	46.2	.16, .37*	Silky.
						33,500	74,500	24.0	34.0	.27*, .21	Silky and fine granular.
253	.29	.87	.350	.035	.042	34,000	65,000	31.5	46.2	.40*, .23	Fine silky.
254	.31	.89	.474	.035	.042	(a)					
255	.29	.86	.360	.039	.042	(a)					
256	.30	.86	.295	.043	.042	40,500	77,000	25.0	37.1	.22, .28*	Silky.
257	.28	.79	.192	.035	.042	36,000	69,000	30.0	43.3	.24, .36*	Fine silky.
258	.29	.81	.230	.035	.042	40,500	77,500	24.0	34.0	.20, .28*	Silky.

a See Forged steel from ingots cast at Watertown Arsenal.

STEEL CASTINGS FOR GUN CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
259	.29	.81	.330	.036	.043	33,000	72,000	29.5	46.2	.32*, .27	Silky.
260	.28	.77	.327	.040	.042	35,000	68,000	28.5	37.1	.31*, .26	Do.
						45,500	79,500	16.0	27.4	.20*, .12	Silky; irregular.
261	.27	.80	.221	.035	.042	32,500	72,000	30.5	46.2	.27, .34*	Silky.
262	.27	.81	.259	.034	.043						
263	.27	.80	.305	.034	.042	32,500	71,500	28.5	43.3	.35*, .22	Do.
264	.26	.76	.289	.035	.042						
265	.28	.80	.366	.035	.042	38,000	77,500	31.0	46.2	.40*, .22	Do.
266	.27	.80	.331	.035	.040	35,000	77,500	26.0	37.1	.29*, .23	Do.
267	.30	.84	.321	.045	.040	31,000	66,000	30.5	46.2	.37*, .24	Do.
						33,000	72,000	30.0	43.3	.22, .38*	Do.
268	.30	.83	.376	.031	.041	36,000	79,000	27.5	37.1	.30*, .25	Do.
						39,000	75,000	28.5	43.3	.30*, .27	Do.
269	.31	.85	.382	.032	.041						
270	.30	.83	.327	.042	.040	34,000	75,000	26.5	43.3	.32*, .21	Do.
						38,000	72,000	30.0	43.3	.34*, .26	Do.
						41,500	78,500	21.0	27.4	.24*, .18	Silky; oblique.
						50,500	82,000	21.0	30.7	.23*, .19	Silky.
271	.31	.84	.381	.039	.040	41,000	76,500	27.5	34.6	.33*, .22	Do.
272	.31	.83	.351	.030	.041	40,500	78,000	26.5	37.1	.24, .29*	Do.
273	.31	.82	.338	.040	.041						
274	.32	.84	.354	.040	.039	45,500	94,500	20.0	27.4	.21*, .19	Granular, 70 per cent; silky, 30 per cent.
						42,000	97,000	18.5	23.9	.22*, .15	Granular; silky spot.
275	.31	.84	.504	.030	.040	32,000	69,000	33.5	49.1	.30, .37*	Silky.
276	.31	.83	.390	.030	.040	33,500	71,000	26.0	34.0	.24*, .28*	Do.
277	.31	.84	.470	.035	.041						
278	.30	.83	.349	.034	.041	50,500	79,000	20.0	30.7	.23*, .17	Dull silky; irregular.
						37,500	83,000	19.5	20.5	.20*, .19*	Granular, 80 per cent; silky, 20 per cent.

STEEL FORGINGS.

GUN AND CARRIAGE WORK.

FORGED STEEL.

From Watertown Arsenal Smith Shop.

75-MILLIMETER MOUNTAIN GUN CARRIAGES.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1YF1	.505	.20	53,000	89,000	18.0	51.9	.08, .28*	Fine silky.
2YF2	.505	.20	52,500	91,000	17.0	49.1	.05, .29*	Do.
1YF2	.505	.20	60,500	109,500	16.5	37.1	.09, .24*	Silky.
1YF59	.505	.20	56,500	100,500	23.0	46.2	.33*, .13	Do.
1YF16	.505	.20	47,500	102,000	19.0	30.7	.20*, .18*	Silky, 80 per cent; granular, 20 per cent.
1YF5	.505	.20	45,000	80,500	29.5	49.1	.39*, .20	Silky.
1YF5-2	.505	.20	42,000	67,500	36.5	66.9	.38*, .33*	Fine silky.
YF83-1	.505	.20	38,000	59,000	36.5	66.9	.32, .41*	Silky; cup-shaped.
YF83-2	.505	.20	34,000	56,500	35.0	64.7	.36*, .34*	Silky.
1YF5-3	.505	.20	49,000	87,500	22.5	54.6	.35*, .10	Do.
132F	.505	.20	55,500	102,500	19.5	37.1	.12, .27*	Do.
1YF1	.505	.20	50,500	67,000	32.1	54.6	.44*, .21	Fine silky.
1YF2	.505	.20	46,000	62,500	34.0	64.7	.32*, .36*	Do.
150F	.505	.20	48,500	92,500	20.5	43.3	.11, .30*	Silky.
280F	.505	.20	53,500	82,000	29.0	64.7	.28, .30*	Fine silky.
267F	.505	.20	36,870	60,340	37.5	68.2	.52*, .23	Do.
271F	.459	.165	49,090	73,330	25.0	67.9	.11, .39	Do.

3-INCH FIELD GUNS.

36BC	.505	.20	70,000	108,000	6.0	9.5	.04, .08*	Granular; flaky spot.
54BC	.505	.20	71,000	100,000	3.5	5.7	.05*, .02	Do.
55BC	.505	.20	70,500	114,000	17.0	40.3	.21*, .13	Silky.
72BC	.505	.20	73,500	117,500	12.5	20.5	.13*, .12	Granular; silky spot.
36BC3	.505	.20	38,000	82,000	21.0	37.1	.13, .29*	Silky.
54BC3	.505	.20	39,000	84,500	14.5	23.9	.09, .20*	Silky; oblique.
55BC3	.505	.20	38,000	81,500	20.0	37.1	.25*, .12	Silky.
72BC3	.505	.20	40,000	84,500	15.5	20.5	.17*, .14	Do.
36BC4	.505	.20	40,500	83,500	10.0	13.2	.08, .12*	Granular, 40 per cent; gray serrated, 60 per cent.
54BC4	.505	.20	42,000	80,500	7.0	9.5	.05, .09*	Granular, 80 per cent; gray serrated, 20 per cent.
55BC4	.505	.20	39,000	84,000	17.0	37.1	.08, .26*	Silky.
72BC4	.505	.20	42,000	85,500	9.0	9.5	.07, .11*	Granular; flaky spot.
37BC5	.505	.20	47,000	90,500	16.0	23.9	.15, .17*	Fine, granular, 60 per cent; silky, 40 per cent.
53BC5	.505	.20	52,500	89,000	20.5	30.7	.16, .25*	Silky.
56BC5	.505	.20	45,500	79,000	6.0	9.5	.08*, .04	Granular; flaky spot.
71BC5	.500	.196	44,900	87,240	18.5	29.1	.22*, .15	Silky.
37BC	.505	.20	43,500	83,500	12.5	16.9	.10, .15*	Granular; silky spot.
53BC	.505	.20	42,500	84,500	15.5	20.5	.14, .17*	Silky.
56BC	.505	.20	45,500	88,500	17.0	27.4	.20*, .14	Granular; silky spot.
71BC	.505	.20	46,000	88,000	21.0	30.7	.21*, .21*	Silky.
37BC7	.505	.20	43,000	88,000	22.0	37.1	.18, .26*	Do.
53BC7	.505	.20	42,000	86,000	20.0	34.0	.22*, .18	Do.
56BC7	.505	.20	44,500	95,500	8.5	13.2	.08, .09	Granular.
71BC7	.505	.20	40,500	85,000	16.0	37.1	.08, .24	Silky.
77BC1	.505	.20	48,000	93,500	23.5	40.3	.17, .30*	Do.
56BC8	.505	.20	44,000	83,500	16.0	40.3	.27*, .06	Silky; oblique.
71BC8	.505	.20	41,500	84,500	19.5	40.3	.28*, .11	Silky.
73BC1	.505	.20	56,000	97,500	9.5	13.2	.08, .11*	Dull silky; serrated.
79BC	.505	.20	54,000	98,000	22.0	37.1	.30*, .14	Silky.
79BC	.505	.20	46,000	94,500	21.0	34.0	.15, .27*	Do.
80BC	.505	.20	48,000	76,500	30.0	64.7	.16, .44*	Fine silky.
92BC	.505	.20	53,500	79,500	32.0	71.3	.16, .48*	Do.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

5-INCH R. F. GUNS.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
5R20RB2	.505	.20	56,000	114,500	10.0	13.2	.13*, .07	Grannular.
5R20RB3	.505	.20	38,500	91,500	22.0	37.1	.13, .31*	Silky, 60 per cent; granular, 40 per cent.

6-INCH R. F. GUNS.

1-6RFGC	.360	.102	102,940	125,390	14.5	51.9	.06, .23*	Fine silky.
2-6RFGC	.360	.102	96,080	122,550	15.5	51.9	.07, .24*	Do.
6RFGC1	.40	.126	70,630	120,630	13.5	43.7	.20*, .07	Do.
6RFGC35	.40	.126	76,190	127,780	10.0	43.7	.15*, .05	Do.
6RFGC74	.40	.126	77,780	125,400	12.5	36.5	.05, .20*	Do.
6RFGC1-2	.40	.126	61,600	99,200	25.0	54.4	.35*, .15	Do.
6RFGC35-2	.40	.126	60,800	100,000	25.5	54.4	.33*, .18	Do.
6RFGC74-2	.40	.126	84,000	116,000	17.5	47.2	.09, .26*	Do.
6RFGC1-3	.40	.126	145,600	176,800	7.0	36.0	.02, .12*	Silky.
6RFGC35-3	.395	.125	100,800	145,600	10.5	47.2	.12*, .09*	Do.
6RFGC74-3	.40	.126	134,400	162,400	10.5	47.2	.17*, .04	Do.
6RFGC1-4	.40	.126	100,800	123,200	13.5	47.2	.21*, .06	Fine silky.
6RFGC35-4	.40	.126	107,200	126,400	14.5	50.4	.05, .24*	Do.
6RFGC74-4	.40	.126	107,200	131,200	15.5	47.2	.08, .23*	Do.

6-INCH DISAPPEARING CARRIAGES.

4RRF10-2	.505	.20	52,000	108,000	18.5	34.0	.18, .19*	Silky.
1RRF10	.505	.20	38,000	75,000	31.5	59.8	.23, .40*	Do.
18RRF5	.505	.20	53,000	104,500	21.5	37.1	.22*, .21*	Do.
3RRF10-2	.505	.20	61,000	113,500	14.5	34.0	.08, .21*	Granular, 50 per cent; silky, 50 per cent.
3RRF10-1	.505	.20	58,000	114,500	15.0	27.4	.10, .20*	Granular; dull, silky spot.
14RRF	.505	.20	60,500	114,500	18.0	37.1	.20*, .16*	Silky.
15RRF	.505	.20	52,500	105,500	18.0	34.0	.10, .26*	Do.
16RRF	.505	.20	44,000	77,500	29.5	54.6	.17, .42*	Fine silky.
17RRF	.505	.20	55,500	111,500	17.5	37.1	.10, .25*	Silky.
18RRF	.505	.20	56,500	114,500	16.0	30.7	.11, .21*	Silky, 60 per cent; granular, 40 per cent.
19RRF	.505	.20	51,500	104,000	20.5	37.1	.21*, .20*	Silky.
7RRF10	.505	.20	49,000	101,500	17.5	40.3	.25*, .10	Do.
16RRF17	.505	.20	35,500	80,500	23.0	37.1	.15, .31*	Silky; trace of granulation.
3RRF10	.505	.20	56,000	115,500	14.5	34.0	.20*, .09	Do.
154-168RRF	.505	.20	45,500	77,000	25.5	54.6	.38*, .13	Fine silky.
9RRF10	.505	.20	40,500	94,500	19.5	34.0	.25*, .14	Silky; trace of granulation.
40RRF10	.505	.20	41,000	93,500	22.0	37.1	.25*, .19	Do.
24RRF10	.505	.20	41,500	93,000	21.0	37.1	.28*, .14	Do.
3RRF10-3	.505	.20	46,000	103,500	17.5	30.7	.16, .19*	Granular, 60 per cent; silky, 40 per cent.
89RRF10	.505	.20	41,000	92,000	22.5	37.1	.26*, .19	Silky.
76RRF10	.505	.20	42,000	93,000	21.5	37.1	.16, .27*	Do.
32RRF10	.505	.20	41,500	93,500	20.5	37.1	.27*, .14	Silky; trace of granulation.
54RRF10	.505	.20	42,000	94,500	20.0	37.1	.28*, .12	Do.
1-24RRF27	.505	.20	56,500	104,500	22.0	46.2	.31*, .13	Fine silky.
32RRF10-2	.505	.20	54,000	91,000	26.5	46.2	.27*, .26*	Silky.
40RRF10	.505	.20	69,000	115,500	20.5	51.9	.31*, .10	Do.
24RRF10	.505	.20	69,500	114,500	20.0	49.1	.10, .30*	Do.
89RRF10-2	.505	.20	67,000	110,500	22.0	51.9	.34*, .10	Do.
9RRF10-2	.505	.20	59,500	100,500	23.0	51.9	.11, .35*	Do.
154-168-3	.505	.20	49,000	76,000	29.5	59.8	.38*, .21	Do.
1RRF9	.505	.20	56,500	112,500	16.0	27.4	.22*, .10	Dull silky, 85 per cent; granular, 15 per cent.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

6-INCH DISAPPEARING CARRIAGES—Continued.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
9RRF9	.505	.20	51,000	100,000	19.5	37.1	.29*, .10	Silky.
13RRF9	.505	.20	54,500	100,000	21.5	43.3	.27*, .16	Do.
17RRF9	.505	.20	57,500	101,000	20.0	40.3	.11, .29*	Do.
71RRF10	.502	.198	40,400	90,910	22.0	36.4	.28*, .16	Do.
1RRF10	.502	.198	46,460	99,490	19.5	33.3	.27*, .12	Silky; trace of granulation.
2RRF10	.505	.20	57,500	114,500	18.5	30.7	.28, .14	Silky.
71RRF10-2	.505	.20	41,000	91,000	22.0	37.1	.16, .28*	Do.
71RRF10-3	.505	.20	48,500	101,000	20.5	37.1	.29*, .12	Do.
21RRF9	.505	.20	53,000	99,500	22.0	37.1	.30*, .14	Do.
25RRF9	.505	.20	57,000	100,000	21.5	37.1	.11, .30*	Do.
29RRF9	.505	.20	51,000	99,500	22.0	40.3	.13, .31*	Do.
33RRF9	.505	.20	57,500	98,500	22.5	46.2	.33*, .12	Do.
1RRF4	.505	.20	45,500	102,500	14.0	16.9	.11, .17*	Granular.
2RRF4	.505	.20	54,000	108,500	14.0	20.5	.20, .06	Do.
1RRF4-2	.505	.20	41,000	101,000	14.5	16.9	.12, .17*	Granular; gray spot.
2RRF4-2	.505	.20	46,000	104,000	17.5	30.7	.23*, .12	Silky; trace of granulation.
1RRF4-3	.505	.20	45,000	92,500	23.0	51.9	.13, .33*	Fine silky.
11RRF40	.505	.20	53,000	98,000	20.5	46.2	.10, .31*	Do.
11RRF41	.505	.20	56,500	92,000	25.5	62.2	.15, .36*	Do.
11RRF42	.505	.20	50,500	100,500	20.5	43.3	.10, .31*	Do.
1RRF31	.505	.20	56,000	100,500	22.0	40.3	.16, .28*	Silky.
15RRF31	.505	.20	51,000	102,000	21.5	37.1	.28*, .15	Do.
15RRF36	.505	.20	47,500	97,500	22.0	40.3	.13, .31*	Do.
7RRF36	.505	.20	44,500	95,500	21.0	37.1	.13, .29*	Do.
1RRF35	.505	.20	54,500	106,000	20.0	30.7	.17, .23*	Do.
21RRF1	.505	.20	44,000	90,000	22.0	40.3	.31*, .13	Silky; trace of granulation.
37RRF9	.505	.20	52,000	97,000	22.5	46.2	.13, .32*	Silky.
40RRF9	.505	.20	53,000	101,000	22.0	46.2	.30*, .14	Do.
43RRF9	.505	.20	52,000	99,000	25.5	40.3	.28*, .23*	Do.
46RRF9	.505	.20	52,000	99,000	21.5	46.2	.30* .13	Do.
49RRF9	.505	.20	52,500	104,500	19.0	43.3	.29*, .09	Do.
52RRF9	.505	.20	51,500	103,500	18.0	37.1	.11, .25*	Do.
55RRF9	.505	.20	51,500	101,500	20.0	43.3	.11, .29*	Do.
58RRF9	.505	.20	51,500	101,500	21.0	43.3	.30*, .12	Do.
60RRF9	.505	.20	51,000	102,000	21.5	43.3	.30*, .13	Do.
F81	.505	.20	59,000	107,000	20.0	30.7	.24*, .16	Silky; oblique.
188F	.505	.20	62,000	93,500	24.5	43.3	.26*, .23*	Fine silky.
22RRF5	.505	.20	52,500	104,500	21.0	37.1	.25*, .17	Silky.
269F	.505	.20	52,500	108,500	11.5	20.5	.07, .16*	Granular.
270F	.505	.20	47,000	104,000	14.5	20.5	.11, .18*	Do.
269-2	.505	.20	48,500	107,500	16.5	27.4	.21*, .12	Granular; silky center.
270F	.505	.20	49,500	107,500	18.5	30.7	.22*, .15	Silky; trace of granulation.
348F	.505	.20	60,500	86,000	17.0	30.7	.12, .22*	Gray; amorphous; opened cracks in stem.
635F	.505	.20	36,500	83,000	22.0	34.0	.20*, .24*	Silky; trace of granulation.
347F	.505	.20	52,500	106,000	21.0	37.1	.17, .25*	Silky.
656F	.505	.20	70,500	126,000	8.0	13.2	.06, .10*	Fine granular.
661F	.505	.20	63,000	113,000	15.0	23.9	.11, .19*	Granular.
645F	.505	.20	37,000	72,500	29.5	46.2	.30*, .29	Silky.
656F-2	.505	.20	57,000	117,500	15.0	30.7	.09, .21*	Fine granular; silky center.
661F-2	.505	.20	64,500	113,000	18.0	34.0	.10, .26*	Do.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

6-INCH BARBETTE CARRIAGES.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1BBF65	.505	.20	58,000	102,500	21.0	30.7	.28*, .19*	Silky, 65 per cent; fine granular, 35 per cent.
1BBF5	.505	.20	51,500	105,500	18.5	27.4	.17, .20*	Silky, 20 per cent: granular, 80 per cent.
1F	.505	.20	46,500	88,000	26.5	49.1	.21, .32*	Silky.
80F	.505	.20	60,500	108,500	20.0	40.3	.11, .29*	Do.
1F2	.505	.20	45,500	89,500	22.5	46.2	.12, .33*	Do.
151F	.505	.20	54,500	114,500	16.5	34.0	.23*, .10	Do.
488F	.505	.20	56,000	108,500	17.0	27.4	.17*, .17	Silky; trace of granulation.
1-9BBF7	.505	.20	57,500	95,500	20.5	43.3	.11, .30*	Fine silky.

7-INCH MORTAR CARRIAGE.

634F	.505	.20	62,500	99,000	17.5	49.1	.28*, .07	Fine silky.

8-INCH DISAPPEARING CARRIAGE.

723F	.505	.20	51,500	87,000	30.0	57.2	.39*, .21	Fine silky; cup shaped.
723F	.505	.20	66,500	103,000	28.0	59.8	.14, .32*	Do.

8-INCH BARBETTE CARRIAGE.

1EF40	.505	.20	49,000	94,500	25.0	40.3	.17, .33*	Silky.
1EF41	.505	.20	49,500	91,000	25.0	46.2	.15, .35*	Do.

10-INCH DISAPPEARING CARRIAGES.

2AAF10–1	.505	.20	46,000	94,500	21.5	37.1	.26*, .17	Silky.
3AAF10–2	.505	.20	46,500	98,500	21.0	40.3	.29*, .13	Do.
4AAF10	.505	.20	47,500	103,500	18.5	30.7	.17, .20*	Granular, 60 per cent; silky, 40 per cent.
5AAF10	.505	.20	47,500	99,500	22.5	40.3	.23*, .22*	Silky.
1AAF53	.505	.20	54,500	98,500	24.0	46.2	.18, .30*	Do.
17AAF5	.505	.20	52,500	94,000	26.0	49.1	.20, .32*	Fine silky.
19AAF5	.505	.20	53,000	106,000	19.0	40.3	.11, .27*	Do.
98AAF10	.505	.20	58,000	109,500	20.0	40.3	.25*, .15	Silky.
102AAF10	.505	.20	53,000	103,500	21.0	37.1	.17, .25*	Do.
111AAF10	.505	.20	58,500	112,000	18.5	34.0	.21*, .16	Silky and granular.
24AAF5	.505	.20	49,000	102,500	20.0	37.1	.26*, .14	Silky.
1AAF54	.505	.20	48,500	99,500	16.5	30.7	.10, .23*	Granular, 50 per cent; silky, 50 per cent.
21AAF5	.505	.20	56,000	104,500	21.5	40.3	.28*, .15	Fine silky.
1AAF54	.505	.20	52,040	103,060	10.0	11.7	.12*, .08	Granular.
3AAF9	.505	.20	55,000	101,500	20.0	43.3	.31*, .09	Silky.
3AAF8	.505	.20	48,000	102,000	15.5	23.9	.20*, .11	Granular; silky spot.
4AAF8	.505	.20	55,500	103,500	17.0	23.9	.11, .23*	Granular, 85 per cent; silky, 15 per cent.
1AAF12	.505	.20	54,000	95,000	23.0	37.1	.20*, .26*	Silky.
6AAF9	.500	.196	53,570	102,040	20.0	44.9	.31*, .09	Do.
5AAF40	.505	.20	59,000	97,000	26.5	49.1	.33*, .20	Do.
16AAF31	.505	.20	50,000	100,500	18.0	37.1	.27*, .09	Silky, 80 per cent; fine granular, 20 per cent.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

10-INCH DISAPPEARING CARRIAGES—Continued.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
6AAF40	.505	.20	51,000	98,500	22.5	37.1	.12, .33*	Silky; trace of granulation.
1AAF54	.505	.20	36,500	89,000	20.5	34.0	.27*, .14	Silky.
1AAF50	.500	.196	51,530	101,530	21.0	42.3	.16, .26*	Fine silky.
1MF60	.505	.20	51,500	101,500	20.0	34.0	.20, .20*	Do.
1AAF64	.505	.20	49,000	100,500	20.0	37.1	.12, .28*	Silky.
9AAF34	.505	.20	68,000	116,000	16.0	37.1	.23*, .09	Silky, 60 per cent; granular, 40 per cent.
5AAF51	.505	.20	56,000	99,500	21.5	43.3	.30*, .18	Silky.
1AAF41	.505	.20	60,500	98,000	21.0	40.3	.14, .28*	Do.
84F	.505	.20	62,000	104,500	21.5	37.1	.16, .27*	Do.
133F	.505	.20	56,000	82,500	28.0	62.2	.20, .36*	Do.
141F	.505	.20	42,500	72,500	28.0	59.8	.23, .33*	Do.
91F	.505	.20	61,000	103,500	19.5	40.3	.29*, .10	Do.
133F	.505	.20	57,500	89,500	25.0	62.2	.25*, .25*	Fine silky.
141F	.505	.20	56,000	83,500	24.0	62.2	.11, .37*	Do.
286F	.505	.20	61,000	92,000	24.0	64.7	.09, .39*	Do.
240F	.505	.20	69,500	114,000	17.5	37.1	.25*, .10	Granular; silky center.
243F	.505	.20	64,000	98,000	23.0	43.3	.14, .32*	Silky.
317F	.505	.20	62,500	97,000	10.0	9.5	.08, .12*	Serrated; oblique.
332F	.505	.20	61,000	102,500	19.0	40.3	.10, .28*	Silky.
275F	.505	.20	49,000	98,500	18.5	37.1	.10, .27*	Silky; trace of granulation.
283F	.505	.20	43,000	77,500	29.0	49.1	.39*, .19	Silky.
301F	.505	.20	67,500	95,000	2.5	1.8	.03*, .02	Coarse granular.
309F	.505	.20	52,000	99,500	15.5	37.1	.08, .23*	Silky.
317F-2	.505	.20	61,000	99,500	17.0	27.4	.21*, .13	Silky; oblique. Opened cracks in stem.
390F	.505	.20	40,500	77,500	30.5	57.2	.36*, .25	Fine silky.
439F	.505	.20	43,000	84,500	26.5	46.2	.35*, .18	Silky.
457F	.505	.20	39,500	78,000	29.5	51.9	.19, .40*	Do.
485F	.505	.20	39,500	63,000	38.5	57.2	.22, .45*	Fine silky.
533F	.505	.20	40,500	60,500	37.5	64.7	.31, .44*	Do.
581F	.505	.20	40,000	61,000	35.5	62.2	.22, .49*	Do.
341F	.506	.20	46,500	75,500	27.0	40.3	.27*, .27*	Silky.
482F	.505	.20	48,000	92,000	23.0	43.3	.32*, .14	Do.
638F	.505	.20	42,500	56,500	40.5	71.3	.33, .48*	Fine silky; cup-shaped.
639F	.506	.20	44,500	56,000	39.5	71.3	.26, .53*	Do.
390F	.505	.20	51,000	88,500	24.0	46.2	.11, .37*	Do.
439F	.505	.20	53,000	94,500	23.5	51.9	.22*, .25*	Do.
457F	.505	.20	53,000	88,000	25.5	57.2	.13, .38*	Do.
642F	.505	.20	65,000	92,500	27.5	57.2	.35*, .20	Do.
632F	.505	.20	47,000	85,500	17.0	20.5	.20*, .14	Granular; silky spot.
744F	.506	.20	61,500	92,000	27.0	54.6	.38*, .16	Fine silky; cup-shaped.
746F	.505	.20	57,000	95,500	24.0	54.6	.12, .36*	Do.
632F-2	.506	.20	52,500	90,500	21.5	59.8	.09, .34*	Do.
748	.505	.20	57,500	88,000	27.0	51.9	.15, .41*	Do.
742F	.505	.20	47,000	77,000	27.0	51.9	.14, .40*	Do.
740F	.505	.20	45,500	82,000	29.0	51.9	.19, .39*	Do.

12-INCH DISAPPEARING CARRIAGES.

1ZF6	.505	.20	44,000	98,500	19.0	27.4	.22*, .16	Granular, 70 per cent; silky, 30 per cent.
1ZF1	.505	.20	56,500	89,500	25.5	46.2	.36*, .15	Silky.
4ZF5	.505	.20	56,500	98,500	24.5	49.1	.16, .33*	Do.
81ZF8	.505	.20	53,000	105,500	17.0	30.7	.10, .24*	Granular; silky spot.
98ZF8	.506	.20	46,000	96,500	19.5	27.4	.19*, .20*	Do.
1ZF34	.505	.20	54,000	108,500	17.5	37.1	.25*, .10	Silky.
73ZF10	.505	.20	43,500	93,000	21.5	30.7	.23*, .15	Silky; trace of granulation.
85ZF10	.505	.20	42,500	95,500	17.0	23.9	.12, .22*	Granular, 85 per cent; silky, 15 per cent.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

12-INCH DISAPPEARING CARRIAGES—Continued.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
94ZF10	.505	.20	48,000	95,500	20.5	27.4	.15, .26*	Granular, 40 per cent; silky, 60 per cent.
1ZF55	.505	.20	55,500	94,500	24.0	46.2	.17, .31*	Silky.
1ZF13	.505	.20	43,000	93,000	20.5	37.1	.12, .29*	Do.
7ZF9	.505	.20	46,500	96,000	16.0	23.9	.08, .24*	Silky; granular spot.
1VF62	.505	.20	39,000	74,000	31.0	51.9	.20, .42*	Silky.
8ZF9	.505	.20	60,000	106,500	22.5	43.3	.27*, .18	Do.
6ZF9	.505	.20	57,000	107,500	18.5	30.7	.25*, .12	Silky, 15 per cent; fine granular, 85 per cent.
1ZF14	.505	.20	73,500	103,500	21.5	59.8	.08, .35*	Fine silky.
1VF62-2	.505	.20	72,000	99,500	21.5	62.2	.35*, .08	Do.
1ZF33	.505	.20	51,000	102,000	19.5	40.3	.10, .29*	Silky.
1ZF36	.505	.20	54,500	106,000	15.0	27.4	.20*, .10	Granular, 85 per cent; dull gray, 15 per cent.
229F	.505	.20	66,500	98,500	22.5	49.1	.12, .33*	Fine silky.
231F	.505	.20	67,500	82,500	32.5	69.2	.29, .36*	Do.
233F	.505	.20	35,500	66,000	28.0	34.0	.29*, .27	Silky; oblique.
233F-2	.505	.20	53,000	81,500	25.5	51.9	.25, .26*	Fine silky.
233F-3	.505	.20	48,500	78,000	22.5	57.2	.09, .36*	Fine silky; cup-shaped.
737F	.505	.20	52,000	83,000	28.5	62.2	.14, .43*	Fine silky.

12-INCH BARBETTE CARRIAGE.

342F	.505	.20	60,000	113,000	7.5	9.5	.06, .09*	Granular.
342F-2	.505	.20	54,500	105,500	18.0	23.9	.17, .19*	Granular; silky spot.

12-INCH MORTAR CARRIAGES.

1TF48	.505	.20	46,500	112,000	12.0	19.6	.15*, .09	Granular.
8TF48	.505	.20	53,000	105,500	17.0	27.4	.25*, .09	Granular, 60 per cent; silky, 40 per cent.
1TF5	.505	.20	54,500	104,500	17.0	27.4	.24*, .10	Granular, 20 per cent; silky, 80 per cent.
1TF26	.505	.20	51,000	103,000	14.0	23.9	.09, .19*	Granular.
339F	.505	.20	62,000	102,500	25.0	49.1	.33*, .17	Fine silky.
640F	.505	.20	51,500	85,500	28.5	57.2	.17, .40*	Fine silky; cup-shaped.
640F-2	.505	.20	61,500	103,000	20.5	49.1	.10, .31*	Fine silky.
753F	.505	.20	64,000	109,500	16.5	62.2	.29*, .14	Fine silky; cup-shaped.
754F	.505	.20	55,500	79,500	32.0	64.7	.42*, .24	Do.
1TF48-2	.505	.20	45,000	97,000	18.5	30.7	.11, .26*	Silky; trace of granulation.

FORGED STEEL—Continued.

FORGINGS FROM INGOTS CAST AT WATERTOWN ARSENAL.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
81F2	.505	.20	61,000	120,500	6.5	9.5	.07*, .06	Granular.
81F4	.505	.20	59,500	119,500	8.0	5.7	.09*, .07	Do.
554F	.505	.20	49,500	104,500	14.5	20.5	.12, .17*	Granular; silky spot.
81F5	.505	.20	57,000	109,000	9.5	13.2	.11*, .08	Do.
1RRF9	.505	.20	51,500	104,500	17.0	27.4	.11, .23*	Silky; trace of granulation.
710FQ	.505	.20	53,000	100,500	7.5	9.5	.09*, .06	Granular.
710FQ2	.505	.20	53,500	102,000	13.0	13.2	.11, .15*	Granular; silky spot.
778QF	.505	.20	59,500	102,500	19.5	30.7	.16*, .23*	Silky; trace of granulation.
810QF	.505	.20	58,000	101,500	18.5	34.0	.15, .22*	Do.
811QF	.505	.20	63,500	101,000	18.0	27.4	.24*, .12	Silky.
777QF	.505	.20	62,000	102,000	13.0	16.9	.12, .14*	Granular; silky spot.
776QF	.505	.20	64,000	102,000	11.0	13.2	.12*, .10	Do.
880QF	.505	.20	52,500	87,500	22.5	34.0	.24*, .21*	Silky; trace of granulation.
777QF2	.505	.20	55,500	99,500	19.5	27.4	.16, .23*	Fine granular; silky center.
776QF2	.505	.20	55,000	100,500	18.5	30.7	.15, .22*	Fine granular, 60 per cent; silky, 40 per cent.
984FQ	.505	.20	55,000	96,500	19.0	27.4	.23*, .15	Granular, 70 per cent; silky, 30 per cent.
186F	.505	.20	54,500	93,000	22.0	40.3	.20*, .24*	Silky.
187F	.505	.20	55,500	99,000	20.5	30.7	.20*, .21*	Silky, interspersed with fine granulation.
234F	.505	.20	41,500	77,000	25.5	43.3	.27*, .24*	Silky.
235F	.505	.20	39,500	74,000	28.0	43.3	.24, .32*	Do.
245F	.505	.20	55,000	92,500	24.0	46.2	.33*, .15	Do.
727F	.505	.20	37,000	71,500	28.0	37.1	.35*, .21	Silky; irregular.
2-81F1	.505	.20	61,000	124,000	11.5	20.5	.15*, .08	Granular; silky spot.
1-81F1	.505	.20	61,500	119,500	7.0	5.7	.05, .09*	Granular.
81F-3	.505	.20	57,140	106,630	22.5	44.9	.30*, .15	Silky.
81F-5B	.505	.20	53,500	103,500	4.0	9.5	.08, .05*	Granular.
81F-5T	.505	.20	51,500	108,000	20.5	37.1	.17, .24*	Silky; trace of granulation.
81F-6B	.505	.20	69,000	101,500	2.5	5.7	.03*, .02	Granular.
81F-6B	.505	.20	70,500	99,000	2.0	5.7	.02, .02*	Do.
81F-6B	.505	.20	69,000	120,500	5.0	9.5	.04, .06*	Granular; seamy.
81F-6T	.505	.20	64,500	122,000	18.0	37.1	.24*, .12	Silky.
81F-6T	.505	.20	66,000	123,000	15.0	34.0	.20*, .10	Do.
81F-7B	.505	.20	72,000	110,500	2.0	1.8	.01, .03*	Granular.
41914B1F3T	.505	.20	51,500	109,000	12.0	9.5	.13*, .11	Granular; silky spot.
41914B1F3L	.505	.20	54,500	112,500	17.0	27.4	.21*, .13	Granular, 50 per cent; silky, 50 per cent.
1BHF61	.564	.25	56,800	112,000	16.0	27.6	.13, .14, .26*, .11	Dull silky, 50 per cent; granular, 50 per cent.
1BHF61-2	.564	.25	56,800	111,600	14.5	27.6	.10, .13, .25*, .10	Dull silky, 40 per cent; granular, 60 per cent.
1BHF61	.564	.25	56,400	112,000	12.8	21.4	.18*, .12, .11, .10	Fine granular, 80 per cent; silky, 20 per cent.
1BHF61-4	.564	.25	57,600	113,200	14.0	24.6	.09, .11, .20*, .16	Fine granular, 90 per cent; silky, 10 per cent.

PARTS OF AMMUNITION TRUCKS.

1XF1	.564	.25	48,000	93,000	23.0	43.3	.31*, .15	Silky.
1XF1	.564	.25	47,500	98,500	20.5	43.3	.31*, .10	Do.
1XF1	.564	.25	59,500	102,000	20.5	46.2	.31*, .10	Fine silky.
1XF25	.564	.25	47,000	100,500	21.5	37.1	.17, .26*	Silky.

FORGED STEEL—Continued.

FROM SPRINGFIELD ARMORY.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
.....	.564	.25	77,500	111,000	25.0	37.1	.25*	Fine silky; trace of granulation.

FROM BOSTON FORGE COMPANY.

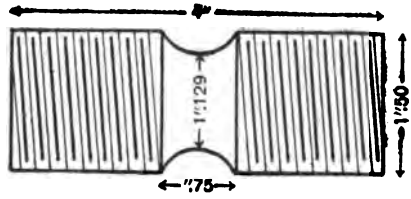
6-INCH BARBETTE CARRIAGE.

.....	.564	.25	59,500	89,500	21.5	54.6	.34*, .09	Silky.

CAST IRON.

TENACITY SPECIMENS.

TENSION TESTS OF CAST IRON.



Tenacity specimens excepting those having elongation given, which latter had stems 6″ or 10″ long each.

FROM WATERTOWN ARSENAL FOUNDRY.

No. of heat.	Description.	Elongation of 0.25 per cent at load per square inch of—	Tensile strength per square inch.	Appearance of fracture.
		Pounds.	*Pounds.*	
314	15-pdr. gun mount		33,200	Fine granular; gray.
314	do		31,600	Do.
275	5-inch barbette carriage.		30,700	Fine granular; light gray.
269	do		33,500	Fine granular; gray.
217	6-inch disappearing carriage, model 1908.		35,500	Do.
216	do		32,000	Do.
216	do		31,300	Do.
216	do		29,600	Do.
215	do		34,500	Fine granular; light gray.
215	do		28,200	Granular; gray.
215	do		30,200	Do.
215	do		30,200	Do.
215	do		30,000	Do.
215	do		31,900	Do.
218	do		36,500	Granular; light gray.
219	do		34,100	Granular; gray.
216	do		34,000	Granular; light gray; bright spot.
216	do		33,700	Granular; light gray.
222	do		33,400	Granular; gray.
219	do		39,100	Fine granular; light gray.
219	do		33,100	Do.
219	do		34,400	Do.
224	do		29,200	Granular; gray.
222	do		34,300	Fine granular; light gray.
222	do		34,100	Do.
224	do		28,100	Fine granular; gray; bright globule.
224	do		35,900	Fine granular; light gray.
222	do		34,900	Do.
222	do		33,400	Do.
223	do		37,300	Granular; gray.
223	do		38,500	Fine granular; light gray.
225	do		29,400	Granular; gray.
226	do		36,200	Do.
227	do		36,500	Fine granular; gray.
225	do		31,200	Do.
225	do		36,600	Do.
225	do		35,100	Do.
225	do		31,100	Do.
226	do		33,100	Do.
226	do		34,400	Do.
226	do		36,000	Do.
226	do		32,100	Do.
230	do		31,200	Do.
229	do		33,400	Fine granular; light gray.
229	do		33,100	Do.
229	do		28,000	Do.
230	do		29,900	Do.
230	do		32,000	Do.
230	do		31,400	Do.
231	do		28,000	Do.
231	do		28,900	Do.
231	do		33,900	Do.
231	do		32,900	Do.
233	do		28,900	Fine granular; gray.
231	do		31,100	Fine granular; light gray.

TENSION TESTS OF CAST IRON—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

No. of heat.	Description.	Elongation of 0.25 per cent at load per square inch of—	Tensile strength per square inch.	Appearance of fracture.
		Pounds.	*Pounds.*	
235	6-inch disappearing carriage, model 1903.	.....	35,200	Granular; gray.
233	.....do.....	.....	30,100	Fine granular; light gray.
235	.....do.....	.....	36,800	Do.
235	.....do.....	.....	35,100	Do.
235	.....do.....	.....	37,200	Do.
235	.....do.....	.....	31,300	Do.
237	.....do.....	.....	31,100	Do.
237	.....do.....	.....	30,100	Do.
237	.....do.....	.....	34,500	Granular; gray.
238	.....do.....	.....	32,500	Fine granular; gray.
241	.....do.....	.....	32,000	Do.
237	.....do.....	.....	36,900	Do.
237	.....do.....	.....	35,000	Do.
239	.....do.....	.....	32,000	Do.
239	.....do.....	.....	37,900	Do.
239	.....do.....	.....	30,900	Do.
239	.....do.....	.....	35,600	Do.
241	.....do.....	.....	32,200	Do.
241	.....do.....	.....	30,200	Do.
241	.....do.....	.....	36,600	Do.
241	.....do.....	.....	34,700	Do.
239	.....do.....	.....	33,400	Do.
240	.....do.....	.....	34,500	Do.
243	.....do.....	.....	32,100	Do.
243	.....do.....	.....	34,000	Do.
243	.....do.....	.....	32,900	Do.
243	.....do.....	.....	31,300	Do.
244	.....do.....	.....	32,500	Do.
242	.....do.....	.....	38,000	Do.
245	.....do.....	.....	35,600	Do.
246	.....do.....	.....	38,000	Do.
245	.....do.....	.....	37,100	Do.
245	.....do.....	.....	35,200	Do.
245	.....do.....	.....	31,100	Do.
245	.....do.....	.....	34,600	Do.
245	.....do.....	.....	30,700	Do.
248	.....do.....	.....	36,800	Do.
248	.....do.....	.....	36,100	Do.
248	.....do.....	.....	33,900	Do.
248	.....do.....	.....	33,400	Do.
249	.....do.....	.....	32,200	Do.
250	.....do.....	.....	30,900	Do.
250	.....do.....	.....	32,000	Do.
250	.....do.....	.....	29,700	Do.
250	.....do.....	.....	31,700	Do.
251	.....do.....	.....	32,000	Do.
252	.....do.....	.....	32,100	Fine granular; light gray.
252	.....do.....	.....	36,200	Do.
252	.....do.....	.....	30,100	Do.
252	.....do.....	.....	32,200	Do.
254	.....do.....	.....	30,700	Do.
254	.....do.....	.....	32,100	Do.
254	.....do.....	.....	35,400	Do.
254	.....do.....	.....	31,300	Do.
252	.....do.....	.....	32,100	Fine granular; gray.
255	.....do.....	.....	29,740	Granular; gray.
225	.....do.....	.....	28,800	Do.
257	.....do.....	.....	38,500	Fine granular; light gray.
258	.....do.....	.....	29,500	Fine granular; gray.
261	.....do.....	.....	29,700	Fine granular; light gray.
262	.....do.....	.....	32,200	Do.
262	.....do.....	.....	31,100	Do.
268	.....do.....	.....	35,000	Fine granular; gray.
261	.....do.....	.....	28,900	Do.
266	.....do.....	.....	28,000	Granular; gray.
267	.....do.....	.....	30,500	Fine granular; gray; spongy.
268	.....do.....	.....	28,000	Fine granular; gray.
271	.....do.....	.....	31,000	Granular; gray.
271	.....do.....	.....	30,400	Do.
273	.....do.....	.....	30,900	Fine granular; light gray.
273	.....do.....	25,400	28,200	Do.
256	.....do.....	28,000	34,500	Do.
274	.....do.....	.....	35,500	Fine granular; gray.

TENSION TESTS OF CAST IRON—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

No. of heat.	Description.	Elongation of 0.25 per cent at load per square inch of—	Tensile strength per square inch.	Appearance of fracture.
		Pounds.	*Pounds.*	
279	6-inch disappearing carriage, model 1903.	.....	32,000	Fine granular; gray.
283	.....do.....	.....	28,900	Do.
283	.....do.....	.....	28,900	Do.
284	.....do.....	.....	31,000	Do.
286	.....do.....	.....	28,900	Do.
288	.....do.....	.....	31,500	Do.
302	.....do.....	28,600	30,200	Granular; gray.
308	.....do.....	.....	36,000	Fine granular; gray.
302	.....do.....	.....	32,700	Do.
302	.....do.....	.....	33,700	Do.
290	.....do.....	.....	31,000	Do.
289	.....do.....	.....	29,800	Do.
289	.....do.....	.....	30,700	Do.
292	.....do.....	.....	32,500	Do.
294	.....do.....	.....	31,500	Do.
338	.....do.....	22,500	30,380	Granular; gray.
293	.....do.....	.....	28,800	Fine granular; gray.
293	.....do.....	.....	31,900	Do.
297	.....do.....	.....	30,500	Do.
298	.....do.....	.....	31,500	Do.
297	.....do.....	.....	32,100	Granular; gray.
299	.....do.....	.....	32,900	Fine granular; gray.
299	.....do.....	.....	31,400	Do.
258	.....do.....	.....	36,000	Do.
312	.....do.....	.....	31,500	Granular; gray.
316	.....do.....	.....	38,000	Fine granular; gray.
317	.....do.....	.....	27,000	Granular; gray.
232	10-inch disappearing carriage.	.....	29,500	Fine granular; light gray.
236	.....do.....	.....	34,000	Fine granular; gray.
242	.....do.....	.....	38,000	Do.
246	.....do.....	.....	38,000	Do.
265	.....do.....	.....	29,800	Do.
265	.....do.....	.....	28,900	Do.
270	.....do.....	.....	28,500	Fine granular; light gray.
270	.....do.....	.....	30,600	Do.
273	.....do.....	.....	31,100	Do.
273	.....do.....	.....	28,200	Do.
248	.....do.....	29,100	33,100	Granular; gray.
249	.....do.....	.....	29,100	Fine granular; light gray.
249	.....do.....	.....	31,100	Do.
278	.....do.....	24,000	28,700	Granular; gray.
278	.....do.....	.....	30,500	Fine granular; light gray.
281	.....do.....	.....	30,900	Granular; gray.
281	.....do.....	.....	29,700	Fine granular; gray.
282	.....do.....	25,900	30,800	Granular; mottled.
282	.....do.....	.....	28,400	Fine granular; light gray.
282	.....do.....	.....	28,300	Do.
283	.....do.....	26,800	34,100	Granular; gray.
283	.....do.....	.....	28,000	Fine granular; gray.
285	.....do.....	25,400	30,400	Do.
285	.....do.....	.....	29,900	Do.
287	.....do.....	.....	33,100	Fine granular; light gray.
287	.....do.....	.....	30,900	Do.
289	.....do.....	.....	28,900	Do.
291	.....do.....	.....	28,800	Do.
293	.....do.....	.....	35,100	Fine granular; gray.
293	.....do.....	.....	37,200	Do.
296	.....do.....	.....	32,200	Do.
296	.....do.....	27,500	31,080	Fine granular; gray; shot hole.
300	.....do.....	25,900	33,200	Granular; gray.
300	.....do.....	.....	30,400	Fine granular; gray.
300	.....do.....	.....	35,300	Do.
304	.....do.....	23,400	29,800	Do.
304	.....do.....	.....	29,000	Do.
304	.....do.....	.....	29,800	Do.
306	.....do.....	25,800	30,900	Do.
308	.....do.....	.....	31,100	Do.
308	.....do.....	.....	32,400	Do.
306	.....do.....	.....	34,200	Do.
309	.....do.....	.....	37,500	Do.
313	.....do.....	.....	30,000	Granular; gray.
315	.....do.....	.....	35,500	Do.

TENSION TESTS OF CAST IRON—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

No. of heat.	Description.	Elongation of 0.25 per cent at load per square inch of—	Tensile strength per square inch.	Appearance of fracture.
		Pounds.	*Pounds.*	
314	10-inch disappearing carriage.	.....	30,400	Granular; gray.
229	12-inch disappearing carriage.	.....	32,100	Fine granular; gray.
229	.....do.....	.....	29,500	Fine granular; light gray.
229	.....do.....	.....	31,400	Do.
234	.....do.....	.....	33,000	Fine granular; gray.
305	.....do.....	.....	35,500	Do.
308	.....do.....	23,600	29,900	Do.
310	.....do.....	.....	28,560	Do.
307	.....do.....	.....	33,000	Do.
295	.....do.....	.....	35,500	Granular; gray.
228	12-inch mortar carriage, model 1896.	.....	36,700	Fine granular; gray.
228	.....do.....	.....	29,000	Do.
247	.....do.....	.....	37,600	Do.
264	.....do.....	.....	38,600	Do.
264	.....do.....	.....	37,200	Do.

FROM THE DETRICK & HARVEY MACHINE COMPANY.

Marks.	Description.	Tensile strength per square inch.	Appearance of fracture.
		Pounds.	
11-1	6-inch disappearing carriage, model 1903.	18,600	Granular; gray.
11-2	.....do.....	24,900	Do.
11-3	.....do.....	23,800	Do.
2-1	.....do.....	27,800	Granular; light gray.
2-2	.....do.....	28,100	Do.
2-3	.....do.....	28,800	Do.
65-1	.....do.....	28,400	Fine granular; light gray.
65-2	.....do.....	28,700	Do.
65-3	.....do.....	30,200	Do.
3-1	.....do.....	31,000	Do.
3-2	.....do.....	29,700	Do.
3-3	.....do.....	29,300	Do.
4-1	.....do.....	28,900	Do.
4-2	.....do.....	31,500	Do.
4-3	.....do.....	29,000	Do.
12-1	.....do.....	26,800	Do.
12-2	.....do.....	22,400	Do.
12-3	.....do.....	26,700	Do.
13-1	.....do.....	24,900	Do.
13-2	.....do.....	23,100	Do.
13-3	.....do.....	22,400	Do.
5-1	.....do.....	30,600	Do.
5-2	.....do.....	32,100	Do.
5-3	.....do.....	32,900	Do.
6-1	.....do.....	26,000	Do.
6-2	.....do.....	26,500	Do.
6-3	.....do.....	26,800	Do.
7-1	.....do.....	30,500	Do.
7-2	.....do.....	30,600	Do.
7-3	.....do.....	28,600	Do.
9-1	.....do.....	30,200	Do.
9-2	.....do.....	28,400	Do.
9-3	.....do.....	30,800	Do.

Specimens which had been broken and then brazed.

Marks.	Tensile strength per square inch.	Appearance of fracture.
	Pounds.	
I-1	17,300	Fractured at root of thread.
13RR 50-2	29,200	Parted at and $\frac{1}{16}$" from original fractured surface.

Cast-iron specimens with plate steel separators across middle of stem. Separators cast in place in the iron.

FROM THE C. H. COWDREY MACHINE COMPANY.

Tensile strength per square inch.	Appearance of fractures.
Pounds.	
19,700 23,100 16,400 24,800 18,800 18,900	Fractures generally occurred through the cast iron, varying, from places in close proximity to the steel separators to a distance of ".3 therefrom, i. e., at the neck of the specimen. In the third specimen tested there was a broad patch, about ".75 by ".75 in outside dimensions, on which the steel was, in part, naked.

Cast-iron specimens for comparison of testing machine at works of S. R. Carr & Co., Baltimore, Md.

FROM THE DETRICK & HARVEY MACHINE COMPANY.

Marks.	Tensile strength per square inch.	Appearance of fractures.
	Pounds.	
1-WA	26,900	Fine granular; dark gray.
2-WA	27,000	Do.
3-WA	27,550	Do.
1-E	37,100	Fine granular; gray.
2	38,200	Do.
3-E	36,100	Do.
4	38,200	Do.

Cast-iron specimen for comparison of testing machine at works of the Driggs-Seabury Ordnance Corporation.

Marks.	Tensile strength per square inch.	Appearance of fracture.
	Pounds.	
DS-2	19,300	Fine granular; brilliant facets.

CAST IRON.

ELONGATION TESTS.

CAST IRON.

ELONGATION TESTS.

TENSILE TESTS OF SPECIMENS FROM CAST IRON FOR 6-INCH DISAPPEARING CARRIAGES, L. F., MODEL 1903, FROM THE DETRICK & HARVEY MACHINE COMPANY, BALTIMORE, MD.

No. 8014.

Gears.
Marks, 2–2 E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	.....	
3,000	.0011	.....	
4,000	.0020	.....	
5,000	.0027	.....	
6,000	.0034	.....	
7,000	.0042	.....	
8,000	.0050	.....	
9,000	.0059	.....	
10,000	.0069	.....	
11,000	.0079	.....	
12,000	.0089	.....	
13,000	.0099	.....	
14,000	.0108	.....	
15,000	.0120	.....	
16,000	.0130	.....	
17,000	.0143	.....	
18,000	.0159	.....	
19,000	.0173	.....	
20,000	.0190	.....	
21,000	.0210	.....	
22,000	.0230	.....	
23,000	.0253	.....	
25,400	.....	.....	Tensile strength.

Fractured ″.65 from the neck.
Appearance of fracture, fine granular, light gray.

No. 8041.

Top carriage.
Marks, 65–1 E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0005	.....	
3,000	.0012	.....	
4,000	.0019	.....	
5,000	.0025	.....	
6,000	.0031	.....	
7,000	.0039	.....	
8,000	.0047	.....	
9,000	.0052	.....	
10,000	.0060	.....	
11,000	.0069	.....	
12,000	.0078	.....	
13,000	.0086	.....	
14,000	.0096	.....	
15,000	.0107	.....	
16,000	.0116	.....	
17,000	.0128	.....	
18,000	.0142	.....	
19,000	.0160	.....	
20,000	.0176	.....	
21,000	.0198	.....	
22,000	.0218	.....	
23,000	.0245	.....	
24,000	.0272	.....	
30,900	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 8050.

Gears.
Marks, 3–1 E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0016	.....	
4,000	.0022	.....	
5,000	.0030	.....	
6,000	.0037	.....	
7,000	.0043	.....	
8,000	.0052	.....	
9,000	.0062	.....	
10,000	.0070	.....	
11,000	.0079	.....	
12,000	.0089	.....	
13,000	.0099	.....	
14,000	.0109	.....	
15,000	.0122	.....	
16,000	.0135	.....	
17,000	.0148	.....	
18,000	.0162	.....	
19,000	.0180	.....	
20,000	.0198	.....	
21,000	.0218	.....	
21,800	.....	.....	Tensile strength.

Fractured 3″.25 from the neck.

Appearance of fracture, fine granular, gray. Smooth, lustrous spot at circumference.

No. 8051.

Gears.
Marks, 4 E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	.....	
3,000	.0011	.....	
4,000	.0017	.....	
5,000	.0024	.....	
6,000	.0030	.....	
7,000	.0039	.....	
8,000	.0047	.....	
9,000	.0055	.....	
10,000	.0062	.....	
11,000	.0070	.....	
12,000	.0079	.....	
13,000	.0089	.....	
14,000	.0098	.....	
15,000	.0109	.....	
16,000	.0119	.....	
17,000	.0129	.....	
18,000	.0143	.....	
19,000	.0156	.....	
20,000	.0170	.....	
21,000	.0187	.....	
22,000	.0204	.....	
23,000	.0225	.....	
24,000	.0248	.....	
25,000	.0275	.....	
26,600	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, fine granular, light gray.

No. 8053.

Gears.
Marks, 5–1 E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0010	.....	
4,000	.0016	.....	
5,000	.0022	.....	
6,000	.0030	.....	
7,000	.0038	.....	
8,000	.0044	.....	
9,000	.0052	.....	
10,000	.0060	.....	
11,000	.0069	.....	
12,000	.0076	.....	
13,000	.0086	.....	
14,000	.0098	.....	
15,000	.0103	.....	
16,000	.0114	.....	
17,000	.0126	.....	
18,000	.0137	.....	
19,000	.0150	.....	
20,000	.0161	.....	
21,000	.0178	.....	
22,000	.0190	.....	
23,000	.0210	.....	
24,000	.0232	.....	
25,000	.0260	.....	
28,100	.....	.....	Tensile strength.

Fractured 3″.50 from the neck.
Appearance of fracture, fine granular, light gray.

No. 8054.

Gears.
Marks, 6–1 E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0015	.....	
4,000	.0021	.....	
5,000	.0031	.....	
6,000	.0040	.....	
7,000	.0048	.....	
8,000	.0054	.....	
9,000	.0067	.....	
10,000	.0076	.....	
11,000	.0088	.....	
12,000	.0099	.....	
13,000	.0107	.....	
14,000	.0121	.....	
15,000	.0132	.....	
16,000	.0149	.....	
17,000	.0160	.....	
18,000	.0180	.....	
19,000	.0198	.....	
20,000	.0221	.....	
21,000	.0242	.....	
21,500	.0265	.....	
23,800	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, fine granular, light gray, granitic.

No. 8063.

Gears.
Marks, 7–1 E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	.....	
3,000	.0009	.....	
4,000	.0014	.....	
5,000	.0020	.....	
6,000	.0029	.....	
7,000	.0033	.....	
8,000	.0042	.....	
9,000	.0050	.....	
10,000	.0060	.....	
11,000	.0068	.....	
12,000	.0078	.....	
13,000	.0088	.....	
14,000	.0099	.....	
15,000	.0110	.....	
16,000	.0122	.....	
17,000	.0135	.....	
18,000	.0150	.....	
19,000	.0161	.....	
20,000	.0182	.....	
21,000	.0197	.....	
22,000	.0221	.....	
23,000	.0249	.....	
24,000	.0276	.....	
25,900	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, fine granular, light gray.

No. 8090.

Brackets for shafts.
Marks, 9–1 E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0005	.....	
3,000	.0010	.....	
4,000	.0018	.....	
5,000	.0024	.....	
6,000	.0032	.....	
7,000	.0089	.....	
8,000	.0046	.....	
9,000	.0052	.....	
10,000	.0061	.....	
11,000	.0070	.....	
12,000	.0079	.....	
13,000	.0088	.....	
14,000	.0097	.....	
15,000	.0107	.....	
16,000	.0118	.....	
17,000	.0129	.....	
18,000	.0140	.....	
19,000	.0152	.....	
20,000	.0168	.....	
21,000	.0182	.....	
22,000	.0200	.....	
23,000	.0220	.....	
24,000	.0242	.....	
25,000	.0273	.....	
26,900	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, fine granular, light gray.

CAST IRON FOR 6-INCH DISAPPEARING CARRIAGES, MODEL 1903 FROM WATERTOWN ARSENAL FOUNDRY.

No. 8064.

Base ring and L. H. chassis.
Marks, 248.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	.....	
3,000	.0010	.....	
4,000	.0016	.....	
5,000	.0020	.....	
6,000	.0024	.....	
7,000	.0030	.....	
8,000	.0037	.....	
9,000	.0043	.....	
10,000	.0048	.....	
11,000	.0055	.....	
12,000	.0060	.....	
13,000	.0068	.....	
14,000	.0072	.....	
15,000	.0081	.....	
16,000	.0090	.....	
17,000	.0097	.....	
18,000	.0106	.....	
19,000	.0113	.....	
20,000	.0124	.....	
21,000	.0133	.....	
22,000	.0145	.....	
23,000	.0158	.....	
24,000	.0170	.....	
25,000	.0187	.....	
26,000	.0205	.....	
27,000	.0223	.....	
28,000	.0245	.....	
29,000	.0273	.....	
33,300	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 8065.

Top carriage and R. H. chassis.
No. 250.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0005	.....	
3,000	.0010	.....	
4,000	.0015	.....	
5,000	.0022	.....	
6,000	.0026	.....	
7,000	.0033	.....	
8,000	.0039	.....	
9,000	.0045	.....	
10,000	.0051	.....	
11,000	.0059	.....	
12,000	.0065	.....	
13,000	.0073	.....	
14,000	.0080	.....	
15,000	.0088	.....	
16,000	.0096	.....	
17,000	.0106	.....	
18,000	.0114	.....	
19,000	.0122	.....	
20,000	.0133	.....	
21,000	.0145	.....	
22,000	.0157	.....	
23,000	.0171	.....	
24,000	.0185	.....	
25,000	.0208	.....	
26,000	.0220	.....	
27,000	.0248	.....	
28,000	.0275	.....	
31,000	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, fine granular, gray.

No. 8068.

Base ring.
Marks, 254.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	
2,000	.0005	.....	Initial load.
3,000	.0010	.....	
4,000	.0017	.....	
5,000	.0022	.....	
6,000	.0030	.....	
7,000	.0035	.....	
8,000	.0041	.....	
9,000	.0049	.....	
10,000	.0056	.....	
11,000	.0064	.....	
12,000	.0070	.....	
13,000	.0080	.....	
14,000	.0088	.....	
15,000	.0098	.....	
16,000	.0107	.....	
17,000	.0116	.....	
18,000	.0127	.....	
19,000	.0140	.....	
20,000	.0153	.....	
21,000	.0168	.....	
22,000	.0187	.....	
23,000	.0204	.....	
24,000	.0230	.....	
25,000	.0257	.....	
28,900	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 8071.

Chassis.
Marks, 1.
Diameter, 1.″129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	.....	
3,000	.0014	.....	
4,000	.0020	.....	
5,000	.0028	.....	
6,000	.0035	.....	
7,000	.0041	.....	
8,000	.0051	.....	
9,000	.0060	.....	
10,000	.0070	.....	
11,000	.0080	.....	
12,000	.0090	.....	
13,000	.0104	.....	
14,000	.0119	.....	
15,000	.0135	.....	
16,000	.0152	.....	
17,000	.0174	.....	
18,000	.0200	.....	
19,000	.0230	.....	
20,000	.0265	.....	
22,900	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, dark gray.

No. 8078.

Top carriage.
Mark, 71.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0005	.....	
3,000	.0010	.....	
4,000	.0013	.....	
5,000	.0022	.....	
6,000	.0029	.....	
7,000	.0036	.....	
8,000	.0042	.....	
9,000	.0050	.....	
10,000	.0057	.....	
11,000	.0066	.....	
12,000	.0074	.....	
13,000	.0083	.....	
14,000	.0092	.....	
15,000	.0103	.....	
16,000	.0115	.....	
17,000	.0124	.....	
18,000	.0138	.....	
19,000	.0150	.....	
20,000	.0165	.....	
21,000	.0194	.....	
22,000	.0202	.....	
23,000	.0227	.....	
24,000	.0250	.....	
25,000	.0278	.....	
27,100	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 8088.

Top carriage.
Marks, 201.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0008	.....	
4,000	.0012	.....	
5,000	.0020	.....	
6,000	.0024	.....	
7,000	.0080	.....	
8,000	.0087	.....	
9,000	.0042	.....	
10,000	.0049	.....	
11,000	.0056	.....	
12,000	.0062	.....	
13,000	.0070	.....	
14,000	.0078	.....	
15,000	.0085	.....	
16,000	.0094	.....	
17,000	.0101	.....	
18,000	.0111	.....	
19,000	.0120	.....	
20,000	.0131	.....	
21,000	.0144	.....	
22,000	.0157	.....	
23,000	.0170	.....	
24,000	.0185	.....	
25,000	.0205	.....	
26,000	.0228	.....	
27,000	.0250	.....	
29,000	.....	.....	Tensile strength.

Fractured 3″.40 from the neck.
Appearance of fracture, granular, gray.

No. 8094.

L. H. Chassis.
Marks, 206.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	.....	
3,000	.0010	.....	
4,000	.0016	.....	
5,000	.0022	.....	
6,000	.0029	.....	
7,000	.0035	.....	
8,000	.0040	.....	
9,000	.0047	.....	
10,000	.0055	.....	
11,000	.0061	.....	
12,000	.0068	.....	
13,000	.0078	.....	
14,000	.0085	.....	
15,000	.0094	.....	
16,000	.0105	.....	
17,000	.0115	.....	
18,000	.0128	.....	
19,000	.0137	.....	
20,000	.0151	.....	
21,000	.0170	.....	
22,000	.0187	.....	
23,000	.0210	.....	
24,000	.0235	.....	
25,000	.0267	.....	
29,500	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

CAST IRON FOR 12-INCH MORTAR CARRIAGES, MODEL 1896, FROM WATERTOWN ARSENAL FOUNDRY.

No. 8066.

Racer.
Marks, 2T10–3.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0002	.....	
3,000	.0004	.....	
4,000	.0007	.....	
5,000	.0010	.....	
6,000	.0013	.....	
7,000	.0016	.....	
8,000	.0019	.....	
9,000	.0022	.....	
10,000	.0025	.....	
11,000	.0029	.....	
12,000	.0032	.....	
13,000	.0036	.....	
14,000	.0040	.....	
15,000	.0044	.....	
16,000	.0049	.....	
17,000	.0053	.....	
18,000	.0058	.....	
19,000	.0063	.....	
20,000	.0068	.....	
21,000	.0072	.....	
22,000	.0077	.....	
23,000	.0083	.....	
24,000	.0090	.....	
25,000	.0098	.....	
26,000	.0108	.....	
27,000	.0114	.....	
28,000	.0123	.....	
29,000	.0135	.....	
30,000	.0148	.....	
31,000	.0164	.....	= 0.27 per cent elongation in 6″.
38,800	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

No. 8079.

Racer.
Marks, 143.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0009	.....	
4,000	.0013	.....	
5,000	.0019	.....	
6,000	.0024	.....	
7,000	.0030	.....	
8,000	.0035	.....	
9,000	.0041	.....	
10,000	.0047	.....	
11,000	.0053	.....	
12,000	.0060	.....	
13,000	.0066	.....	
14,000	.0072	.....	
15,000	.0080	.....	
16,000	.0085	.....	
17,000	.0094	.....	
18,000	.0108	.....	
19,000	.0110	.....	
20,000	.0120	.....	
21,000	.0128	.....	
22,000	.0137	.....	
23,000	.0150	.....	
24,000	.0160	.....	
25,000	.0173	.....	
26,000	.0187	.....	
27,000	.0202	.....	
28,000	.0223	.....	
29,000	.0245	.....	
30,000	.0264	.....	
87,900	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

EXPERIMENTAL MIXTURE OF CAST IRON, WATERTOWN ARSENAL FOUNDRY.

No. 8087.

Marks, 3.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	.....	
3,000	.0010	.....	
4,000	.0017	.....	
5,000	.0023	.....	
6,000	.0030	.....	
7,000	.0037	.....	
8,000	.0046	.....	
9,000	.0054	.....	
10,000	.0062	.....	
11,000	.0070	.....	
12,000	.0081	.....	
13,000	.0090	.....	
14,000	.0101	.....	
15,000	.0112	.....	
16,000	.0125	.....	
17,000	.0137	.....	
18,000	.0153	.....	
19,000	.0170	.....	
20,000	.0188	.....	
21,000	.0210	.....	
22,000	.0232	.....	
23,000	.0264	.....	
23,800	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

CAST IRON FOR 10-INCH DISAPPEARING CARRIAGES, MODEL 1901, FROM WATERTOWN ARSENAL FOUNDRY.

No. 8089.

Top carriage.
Marks, 203.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	.....	
3,000	.0012	.....	
4,000	.0017	.....	
5,000	.0024	.....	
6,000	.0030	.....	
7,000	.0037	.....	
8,000	.0043	.....	
9,000	.0049	.....	
10,000	.0056	.....	
11,000	.0064	.....	
12,000	.0070	.....	
13,000	.0080	.....	
14,000	.0086	.....	
15,000	.0098	.....	
16,000	.0105	.....	
17,000	.0113	.....	
18,000	.0125	.....	
19,000	.0136	.....	
20,000	.0150	.....	
21,000	.0162	.....	
22,000	.0178	.....	
23,000	.0198	.....	
24,000	.0216	.....	
25,000	.0239	.....	
26,000	.0268	.....	
29,700	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, granular, gray.

CHEMICAL ANALYSES.

CAST AND PIG IRONS AND STEEL.

CHEMICAL ANALYSES OF PIG IRONS.

Description.	Total carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
Bessemer pig, 14632	3.35	.71	2.280	.025	.084
L. V. 11899 No. 1	3.37	.....	1.800	.025	.083
L. V 11899 No. 2	3.49	.....	2.500	.030	.046
Bessemer pig 44881 No. 1	3.60	3.95	1.500	.024	.082
Bessemer pig 44881 No. 2	3.62	4.26	1.550	.024	.033
P R. R. 17895	.....	.....	2.84	.015	.080
P. R. R. 12898	.....	.....	2.44	.015	.082
No. 4677	.....	.12	2.400	.015	.080
C. V. R. R. 1031	.....	.11	2.75	.015	.080
No. 166720	.....	.11	2.57	.019	.080
No. 18220	.....	.11	2.40	.024	.033
No. 19042	.....	.11	2.96	.021	.082
Murkirk pig	.....	.96	1.22	.200	.347
Hinckle No. 1, car 1402	.....	.74	2.16	.025	.090
Hinckle No. 1, car 2869	.....	.74	2.20	.020	.090
Hinckle No. 1, car 71210	.....	.75	2.83	.020	.095
Marshall pig No. 1	.....	.89	2.93	.055	1.310 1.250
Bessemer pig	.....	.73	2.28	.036	.020
Hinckle No. 1	.....	.....	2.000	.028	.111
P. O. 1292	.....	.61	2.750	.035	.737
Car 65182, P. O. 1847	.....	.60	2.20	.020	.038
Car 25745, P. O. 1847	.....	.50	2.20	.020	.038
Car 26565, P. O. 1847	.....	.59	2.04	.027	.039
P. O. 1847	.....	.56	2.35	.028	.039
P. O. 1431	.....	.45	3.35	.025	.550
Rome iron, P. O. 1442	.....	.74	2.51	.030	.475
Car 92641	.....	.50	2.850	.015	.027
Car 4070	.....	.55	3.450	.017	.031
Car 102378	.....	.50	2.420	.015	.030
C. V. R. R. 200	3.70	.12	2.65	.015	.052

CHEMICAL ANALYSES OF CAST IRON FROM ARSENAL FOUNDRY.

Description.	Carbon.			Manganese.	Silicon.	Sulphur.	Phosphorus.
	Total.	Graphitic.	Combined.				
Specimen No. 224	2.958	2.286	.722	.41	1.23	.109	.487
Specimen No. 226	2.455	1.986	.469	.43	1.20	.117	.492
Specimen Nos. 229-1	2.960	1.952	1.008	.46	1.18	.147	.498
Specimen No. 237	.....	2.151	.....	.43	1.16	.147	.504
Heat No. 337	2.890	1.908	.982	.38	1.120	.118	.200

CHEMICAL ANALYSES OF SPECIMENS FROM B HOOP, FORGED FROM ARSENAL INGOT.

Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
.48	.97	.460	.035	.044
.....	.75	.170	.030	.020

CHEMICAL ANALYSES OF GUN-BARREL STEEL FROM SPRINGFIELD ARMORY.

Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Tungsten.
.614	.570	.383	.025	.028	.890
.500	.787	.600	.045	.045	

CHEMICAL ANALYSIS OF 1-POUNDER STEEL SHELL FROM FRANKFORD ARSENAL.

Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
.20	.416	.005	.042	.082

CHEMICAL ANALYSIS OF 5-INCH R. F. GUN FORGING.

Marks.	Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
5R20RB3	.65	.65	.269	.027	.023

CHEMICAL ANALYSIS OF STEEL RAIL NO. 66.

Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Nickel.
.564	.80	.047	.042	.058	2.50

BRONZE.

BRONZE.

The elastic limits stated are approximations, and signify the loads at which the specimens showed increased rates of elongation.

From Watertown Arsenal Foundry.

75-MILLIMETER MOUNTAIN GUN CARRIAGES.

Marks and descriptions.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
541	20,500	31,000	4.5	5.7	.06*, .08	Lavender and light yellow.
556	22,000	33,500	5.0	1.8	.06, .04	Lavender.
591	20,500	32,000	6.0	1.8	.05, .07*	Lavender and light yellow.
651	19,000	35,000	11.0	5.7	.10, .12*	Do.
652	20,500	30,500	5.0	1.8	.02, .06*	Do.
654	21,500	46,500	22.0	27.4	.22, .22	Do.
659	20,500	29,000	4.5	1.8	.08, .06	Do.
662	20,500	33,500	5.0	5.7	.07*, .08	Do.
663	19,000	45,500	21.5	27.4	.20, .23*	Do.
664	18,500	36,000	13.0	16.9	.12, .14*	Do.
716	19,000	36,000	10.0	9.5	.09, .11*	Light yellow.
717	18,500	33,000	7.0	9.5	.05, .09*	Light yellow and lavender.
719	20,000	38,500	17.0	16.9	.16, .18*	Light yellow.
720	19,000	41,000	22.0	20.5	.26*, .18	Do.
721	20,000	33,500	6.5	5.7	.08*, .05	Light yellow and lavender.
722	17,500	28,000	4.0	5.7	.05*, .03	Do.
187	21,000	31,000	5.5	5.7	.05, .06*	Light yellow and lavender.
188	19,000	40,500	24.5	20.5	.26*, .23	Light yellow.
189	22,000	38,000	12.5	20.5	.10, .15*	Do.
190	26,500	40,500	4.5	5.7	.03, .06*	Lavender color.
191	22,500	38,000	11.5	16.9	.11, .12*	Do.
192	21,000	34,000	12.5	18.2	.11, .14*	Light yellow.
193	21,000	33,000	5.0	5.7	.06*, .04	Lavender color.
194	19,500	33,500	9.0	18.2	.10*, .08	Light yellow.
208	21,500	26,000	2.5	9.5	.00, .05	Light and golden yellow.
212	27,500	46,000	3.5	13.2	.03, .04	Dark yellow; dark green; spongy.
223	21,500	53,000	20.0	27.4	.18, .22*	Light yellow.
230	22,000	51,000	11.5	16.9	.10, .13*	Light yellow and lavender.
209	21,500	36,500	10.5	18.2	.12*, .09	Do.

Bronze—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

75-MILLIMETER MOUNTAIN GUN CARRIAGES—Continued.

Marks and descriptions.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
220	18,500	34,000	6.5	9.2	.05, .08*	Light yellow and lavender.
224	20,500	36,500	12.5	13.2	.12, .13*	Do.
215	22,080	34,420	9.0	9.7	.10*, .08	Dark yellow.
235	22,440	27,560	8.0	19.2	.11*, .05	Do.
240	20,500	40,500	19.0	13.2	.20*, .18	Do.
244	21,000	38,000	12.0	13.2	.12, .12*	Do.
449	23,000	45,500	17.5	16.9	.14, .21*	Do.
476	20,500	40,000	18.0	16.9	.21*, .15	Do.
520	21,000	31,500	4.0	1.8	.06*, .02	Dark yellow and lavender.
530	20,500	33,500	7.5	1.8	.09*, .06	Do.

15-POUNDER GUN MOUNTS.

580	32,500	76,000	25.0	27.4	.25*, .25*	Light yellow.
643	23,500	51,500	12.5	13.2	.13, .12	Light and lemon yellow.
649	24,000	52,500	14.0	16.9	.12, .16*	Do.
1386	.....	65,500	16.5	20.5	.18*, .15	Light yellow.
1398	.....	30,500	8.5	9.5	.07, .10	Brownish yellow.

5-INCH BARBETTE CARRIAGES.

From Watervliet Arsenal	43,000	64,100	44.0	53.4	.42*, .46*	Uniform light yellow; fine silky.

44RR100	22,000	54,500	20.5	27.4	.17, .24*	Light yellow.
29RR99	30,500	75,000	29.5	30.7	.33*, .26	Light yellow; silky.
26RR99	30,000	74,000	36.0	40.3	.30, .42*	Do.
16-18RR101	30,500	68,000	20.5	27.4	.17, .24*	Light yellow.
1-4RR101	30,500	71,000	27.5	30.7	.24, .31*	Do.
5-8RR101	31,000	73,000	26.5	30.7	.27*, .26*	Do.
9-12RR101	31,000	78,000	22.5	27.4	.20, .25*	Do.
30-31RR99	27,000	45,500	6.0	9.5	.02, .10*	Light yellow; dark golden spot.
45-48RR100	21,500	56,500	20.0	30.7	.23*, .17	Light yellow.
13-15RR101	26,000	72,500	24.0	27.4	.21, .27*	Do.
4-7RR108	29,500	70,500	24.0	23.9	.22, .26*	Do.
22RR99	30,500	73,000	32.0	30.7	.35*, .29	Do.
22-24RR97-2	29,000	74,500	35.0	37.1	.30, .40*	Do.
8-13RR108	32,000	68,000	18.0	20.5	.17*, .19	Do.
19RR101	33,000	72,000	24.0	20.5	.26*, .22	Do.
20RR101	31,000	71,500	22.5	27.4	.21, .24*	Do.
21RR101	31,000	72,000	22.0	30.7	.19, .25*	Do.
1-13	23,000	62,000	24.5	30.7	.22, .27*	Do.
30-31RR109	29,000	45,000	5.5	16.9	.09*, .02	Light and lemon yellow.
14-16	27,000	71,500	21.0	23.9	.19, .23*	Light yellow.
24-26	30,500	73,000	25.5	27.4	.27*, .24	Do.
14-16-2	30,500	71,500	27.0	27.4	.30*, .24	Do.
58-59	20,500	52,500	18.5	20.5	.16, .21*	Dark yellow.
65-66	28,000	69,000	23.0	27.4	.20, .26*	Light yellow.
60-64	20,500	51,500	16.5	20.5	.17*, .16*	Dark yellow and lemon yellow.
68-76	31,000	73,000	23.0	27.4	.20, .26*	Light yellow.
77-85	28,000	74,000	19.0	20.5	.21*, .17	Do.
91-96	26,500	72,500	26.0	23.9	.25, .27*	Do.
108-107	21,500	56,500	21.5	27.4	.23*, .20	Do.
111-113	28,000	57,500	22.0	23.9	.23*, .21	Light yellow; streaks of lemon yellow.
114-115	24,000	59,500	22.0	27.4	.23*, .21	Light yellow.
266	31,000	72,000	14.5	20.5	.17*, .12	Do.
156-158	22,000	59,000	23.5	20.5	.21, .26*	Light yellow and lemon yellow.
159	24,000	62,500	28.5	30.7	.33*, .24	Light yellow.
160	20,500	62,000	29.0	30.7	.33*, .25	Light yellow; oblique.
161	23,000	59,000	32.5	34.0	.28, .37*	Light yellow.
162	23,500	59,500	25.0	27.4	.27*, .23	Do.
163	25,500	58,000	25.5	30.7	.30*, .21	Do.
164	21,500	48,500	15.5	23.9	.19*, .12	Do.
165-1	25,500	59,500	26.5	27.4	.26, .27*	Do.
166-1	23,000	58,500	25.0	30.7	.26*, .24	Do.
167-1	24,000	60,200	26.5	29.1	.30*, .23	Do.
168-1	23,000	61,500	25.0	27.4	.23, .27*	Do.
169-1	22,500	60,500	23.0	27.4	.19, .27*	Do.
171-1	24,000	59,500	20.0	23.9	.17, .23*	Do.
172-1	22,500	58,000	21.5	23.9	.24*, .19	Do.
173	19,500	58,500	26.5	34.0	.22, .31*	Do.
174	18,000	59,500	25.0	27.4	.23, .27*	Do.
175	23,000	58,500	19.5	23.9	.19, .20*	Light yellow; spongy.

Bronze—Continued.

From Watertown Arsenal Foundry—Continued.

6-INCH DISAPPEARING CARRIAGES—Continued.

Marks and descriptions.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.		Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	"	"	
176	21,500	58,000	28.5	29.1	.21,	.26*	Light yellow.
177	23,000	54,000	17.5	20.5	.19*,	.16*	Light yellow; irregular.
178	21,000	62,000	29.0	29.1	.32*,	.26	Light yellow.
179	21,500	58,500	28.0	30.7	.30*,	.26	Light yellow; silky.
197	22,500	62,000	24.5	30.7	.23,	.26*	Light yellow.
195	21,500	52,500	19.0	28.9	.16,	.22*	Do.
198	22,000	56,000	19.0	27.4	.20*,	.18	Do.
199	23,000	62,500	27.5	34.0	.25,	.30*	Do.
200	22,000	63,500	25.5	30.7	.23,	.28*	Do.
201	22,500	53,000	18.5	20.5	.20*,	.17	Do.
202	22,000	62,000	35.5	40.3	.42*,	.29	Do.
236	20,500	58,000	17.0	20.5	.20*,	.14	Do.
259	21,500	48,500	11.5	16.9	.09,	.14*	Light yellow and lemon color.
266	32,000	71,000	17.5	20.5	.21*,	.14	Light yellow.
275	20,500	46,000	10.0	16.9	.07,	.13*	Light yellow; lemon-colored center.
245-2	31,500	72,000	19.5	23.9	.18,	.21*	Light yellow.
287	31,000	74,000	24.5	27.4	.22,	.27*	Do.
288	30,500	72,500	20.0	27.4	.23*,	.17	Do.
320	23,500	73,000	26.0	30.7	.28*,	.24	Do.
335	31,000	72,500	30.5	30.7	.27,	.34*	Do.
385	23,000	70,500	23.5	23.9	.25*,	.22	Do.
327-2	34,000	74,500	23.0	23.9	.20,	.26*	Do.
339	35,500	70,500	21.0	23.9	.25,	.27*	Do.
346	24,000	60,500	26.0	27.4	.23*,	.24	Light yellow; oblique.
347	24,500	45,000	7.5	16.9	.10*,	.05	Light yellow and lemon color.
351	22,500	29,500	4.0	13.2	.01,	.07*	Light yellow and lemon color. Spongy.
351-2	22,000	44,500	5.0	16.9	.04,	.06	Light yellow and lemon color.
356-2	20,500	40,000	9.5	16.9	.15*,	.04	Do.
361	25,500	48,500	6.0	9.5	.08*,	.04	Do.
366	20,000	38,500	8.0	13.2	.04,	.12*	Do.
370	23,000	48,000	12.5	13.2	.16*,	.09	Do.
359	22,500	50,000	6.0	9.5	.08*,	.04	Do.
366	20,500	51,000	15.5	20.5	.12,	.19*	Do.
374	21,500	45,000	9.0	13.2	.06,	.12*	Do.

381	22,000	43,000	10.0	20.5	.13*, .07	Do.
385	20,500	40,000	7.0	9.5	.10*, .04	Do.
387	21,500	57,000	23.0	23.9	.21, .25*	Light yellow.
389	21,000	56,000	17.5	27.4	.20*, .15	Light yellow and lemon yellow.
381-2	18,500	32,500	5.0	9.5	.08, .07*	Do.
385	20,500	37,500	6.0	16.9	.08, .09*	Light yellow, dark golden, and lemon yellow.
398	21,500	57,000	18.5	23.9	.20*, .17	Light yellow and lemon yellow.
401	20,500	54,500	17.0	20.5	.19*, .17	Do.
404	24,500	54,500	18.0	16.9	.19*, .17	Do.
407	37,000	76,000	18.5	20.5	.20*, .17	Light yellow.
393	23,000	54,000	17.5	20.5	.16, .19*	Light yellow and lemon color.
397	25,500	58,000	6.5	9.5	.10, .08	Light yellow, dark golden, and lemon yellow.
460	39,500	79,000	27.0	27.4	.29*, .25	Light yellow.
478	39,000	76,000	20.5	23.9	.20*, .21*	Do.
486	35,000	48,000	4.0	9.5	.06*, .02	Light yellow and golden yellow.
497	38,500	62,000	10.5	13.2	.09, .12*	Light yellow.
486	35,000	67,500	13.5	16.9	.11, .16*	Do.
508	33,000	71,500	17.0	20.5	.14, .20*	Do.
510	35,500	74,000	32.0	37.1	.25, .39*	Do.
512	34,000	69,500	15.0	20.5	.14, .16*	Do.
497-2	39,500	72,500	19.0	20.5	.17, .21*	Do.
514	38,000	74,500	30.5	27.4	.25, .36*	Do.
515	35,500	74,000	21.0	20.5	.23*, .19	Do.
516	37,000	74,000	22.0	20.5	.21, .23*	Do.
524	35,000	71,000	29.5	27.4	.31*, .23	Do.
531	35,500	75,000	25.0	27.4	.27*, .23	Do.
536	34,000	69,000	19.0	20.5	.21*, .17	Do.
542	33,000	70,000	35.5	37.1	.43*, .28	Do.
570	35,500	72,500	26.0	23.9	.23*, .24	Do.
582	35,500	75,000	23.0	23.9	.21, .25*	Do.
588	36,000	72,500	13.0	16.9	.12, .14	Do.
592	35,000	77,500	20.0	23.9	.21*, .19	Do.
637	34,000	69,500	21.0	23.9	.18, .24*	Do.
641	33,000	70,000	26.5	23.9	.30*, .23	Do.
645	34,000	74,000	24.0	23.9	.25*, .23	Do.
705	19,500	42,000	7.0	16.9	.09*, .05	Lavender; yellow spot.
706	17,000	50,500	14.0	20.5	.15*, .13	Do.
727	19,500	37,500	17.0	16.9	.19*, .15	Light yellow.
748	18,000	57,000	38.0	37.1	.32, .44*	Light yellow; silky.
785	18,000	32,000	4.0	9.5	.02, .06*	Lavender and lemon yellow.
838	30,500	71,000	17.5	20.5	.20*, .15	Light yellow.
864	31,000	72,500	23.0	23.9	.20, .26*	Do.
987	20,500	46,500	5.0	5.7	.05*, .05	Light and lemon yellow.
1015	21,500	52,500	9.5	16.9	.12*, .07	Light yellow.
1030	20,500	49,000	9.5	13.2	.07, .12*	Light and lemon yellow.
1044	25,500	41,500	5.0	9.5	.09*, .02	Lavender and lemon yellow.
1066	25,000	51,500	10.0	16.9	.13*, .07	Light and lemon yellow.
1044-2	25,500	61,500	17.0	13.2	.18*, .16	Do.
1110	31,500	74,000	35.0	37.1	.41*, .29	Light yellow.
1147	28,500	76,000	16.5	20.5	.18*, .15	Do.
1195	28,000	78,000	32.0	30.7	.30*, .34*	Do.
1199	27,000	77,500	31.0	30.7	.30*, .32*	Do.

Bronze—Continued.

From Watertown Arsenal Foundry—Continued.

6-INCH DISAPPEARING CARRIAGES—Continued.

Marks and descriptions.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
1201	27,000	72,500	28.0	27.4	.29*, .27	Light yellow.
1258	26,500	76,500	32.0	30.7	.31*, .33*	Do.
1268	29,000	76,000	32.0	27.4	.35*, .29	Do.
1292	35,000	80,000	12.5	13.2	.13*, .12	Do.
1296	33,000	77,000	11.5	13.2	.14*, .09	Light yellow; fine granular.
1301	23,000	69,500	17.5	23.9	.20*, .15	Light yellow; fine silky.
1317	27,000	74,500	22.5	23.9	.20, .25*	Light yellow.
1334	29,000	69,000	16.5	23.9	.14, .19*	Do.
1357	27,000	75,500	20.0	23.9	.19, .21*	Do.
446	30,500	68,000	22.0	30.7	.21, .23*	Do.
446	30,000	67,000	18.0	23.9	.19*, .17	Do.
495	33,000	70,000	23.5	27.4	.22, .25*	Do.
1280	24,000	51,000	6.5	13.2	.06, .07*	Lavender and lemon yellow; irregular.
1406	28,000	71,000	21.0	23.9	.18, .24*	Light yellow.
1414	31,000	69,000	15.0	20.5	.13, .17*	Do.
1420	.....	49,500	6.0	13.2	.04, .08*	Light yellow and lemon color.

6-INCH BARBETTE CARRIAGES.

27-52-1	21,000	54,000	28.0	27.4	.19, .27*	Dark yellow.
1BBF58	30,400	60,400	44.0	59.2	.30, .58*	Light yellow; silky.
2BBF58	30,800	60,200	43.0	60.8	.59*, .27	Light yellow; fine silky.
3BBF58	32,200	60,200	43.5	62.2	.31, .56*	Do.
4BBF58	37,600	60,200	43.5	57.6	.36, .51*	Do.
5BBF58	37,600	62,200	38.5	54.2	.33, .44*	Do.
6BBF58	35,000	57,200	41.5	62.2	.64*, .19	Do.
7BBF58	35,800	60,200	40.0	54.2	.25, .55*	Do.
8BBF58	35,400	59,400	42.5	47.2	.36*, .49*	Do.
9BBF58	30,400	57,400	45.5	59.2	.60*, .31	Do.
10BBF58	33,600	58,400	49.5	57.6	.40, .59*	Do.
11BBF58	30,200	56,400	45.0	59.2	.28, .62*	Do.

12BBF58	36,000	60,400	44.0	55.8	.55*, .33	Do.
9BBF58	33,060	58,060	44.5	61.9	.27, .62	Do.
10BBF58	45,200	61,800	35.0	57.6	.39, .50	Do.
8BBF58-2	50,400	63,600	31.0	54.2	.18, .49*	Do.
6BBF58-2	44,800	64,200	37.5	57.6	.28, .52*	Do.
11BBF58-2	59,600	71,600	28.0	52.4	.46*, .10	Do.
11BBF?8-3	38,600	61,800	42.5	60.8	.27, .58	Do.
522	21,500	38,000	8.0	1.8	.00, .06*	Light and lemon yellow.
9BBF58	57,400	67,600	24.0	35.6	.34*, .14	Light yellow; fine silky.
723	22,500	61,000	31.0	30.7	.36*, .26	Light yellow.
986	21,500	55,500	14.5	20.5	.17*, .12	Do.
246F	35,200	57,800	40.5	50.8	.23, .58*	Light yellow; fine silky.
247F	36,000	59,000	40.5	60.8	.21, .60*	Do.
738F	.....	61,400	38.5	52.4	.37*, .40*	Do.
739F	.....	69,400	27.5	49.0	.29*, .26*	Do.

8-INCH DISAPPEARING CARRIAGES.

143	28,000	61,000	38.0	43.3	.43*, .38	Light yellow.

10-INCH DISAPPEARING CARRIAGES.

4-5AA114	81,500	71,000	22.0	27.4	.23*, .21	Light yellow.
7AA113	29,500	73,500	34.0	37.1	.38*, .30	Light yellow; oblique.
17-18AA135	29,500	74,500	28.5	30.7	.29*, .28*	Light yellow.
7AA113-2	28,000	72,000	19.5	27.4	.18, .21*	Do.
8AA113	30,500	69,500	21.5	30.7	.23*, .20	Do.
10-12AA114	32,000	74,000	29.0	34.0	.26, .32*	Do.
9AA113	32,000	73,500	29.5	34.0	.27, .32*	Do.
10AA113	32,000	72,000	29.5	30.7	.32*, .27	Do.
17-20	28,000	74,500	34.0	34.0	.34*, .34*	Do.
21-23	29,000	76,000	32.0	34.0	.32*, .32*	Do.
17-20-2	27,000	73,500	35.0	37.1	.39*, .31	Do.
21-23-2	31,000	74,500	31.0	34.0	.35*, .27	Do.
67	27,500	67,000	17.0	23.9	.15, .19*	Light yellow; irregular.
86-90	28,000	74,000	33.5	34.0	.37*, .30	Light yellow.
4-7-RR-102-?	27,000	68,000	21.0	27.4	.18, .24*	Do.
97-99	26,000	78,000	25.0	27.4	.26*, .24	Do.
101-102	27,500	78,000	24.0	37.1	.38*, .30	Do.
108-110	26,500	74,500	26.5	30.7	.26*, .27*	Do.
116-131	20,500	52,500	16.5	23.9	.18, .20*	Light and lemon yellow.
132-142	22,500	57,000	19.0	23.9	.17, .21*	Light yellow.
144-146-1	28,000	78,000	32.5	34.0	.32*, .33*	Do.
144-146-2	28,000	74,000	31.5	34.0	.34*, .29	Do.
144-146-3	24,500	74,500	32.0	34.0	.33, .31*	Do.
144-146-4	27,000	73,000	26.5	30.7	.23, .30*	Do.

Bronze—Continued.

From Watertown Arsenal Foundry—Continued.

10-INCH DISAPPEARING CARRIAGES—Continued.

Marks and descriptions.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.			Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	"	"	"	
147–155	22,000	56,000	18.0	23.9		.20*	.16	Light yellow and lemon color.
AA1–981	88,180	57,600	42.0	47.5	.33,	.60*	.33	Light yellow; oblique.
AA1–2–981	88,980	60,580	41.5	43.5		.44*	.39*	Do.
217	17,000	36,000	34.0	34.0		.39*	.29	Light yellow.
225	33,000	69,000	14.0	20.5		.18,	.15*	Do.
242	16,500	33,000	33.0	30.7		.30*	.26	Golden yellow.
268	16,500	34,500	27.0	27.4		.33*	.21	Do.
699	19,000	49,500	16.0	20.5		.19*	.13	Do.
280	17,000	34,500	24.0	27.4		.29*	.19	Do.
286	32,000	71,500	20.0	23.9		.22*	.18	Light yellow.
290	18,000	32,000	19.5	27.4		.17,	.22*	Golden yellow.
293	30,000	70,500	16.5	23.9		.20*	.13	Light yellow.
294	17,860	32,650	20.0	29.1		.15,	.25*	Golden yellow.
295	31,000	72,000	18.5	20.5		.17,	.20*	Light yellow.
305	20,500	48,000	39.5	37.1		.38,	.41*	Do.
309	31,500	73,500	19.0	23.9		.16,	.22*	Do.
313	37,500	73,500	21.5	23.9		.20,	.23*	Do.
270	22,000	52,500	41.5	40.3		.46*,	.37	Do.
411	22,000	50,000	11.5	16.9		.06,	.15*	Light yellow and lemon color.
425	19,500	29,600	13.5	16.9		.10,	.17*	Golden yellow.
450	15,000	19,500	3.0	1.8		.01,	.05*	Light and golden yellow.
462	16,500	34,000	26.5	20.5		.22,	.31*	Dark yellow.
453	17,500	31,500	13.0	13.2		.12,	.14*	Light and dark yellow.
474–2	16,400	29,000	14.5	11.6		.18*,	.11	Dark and golden yellow.
546	33,000	58,000	9.0	13.2		.07,	.11*	Light and lemon yellow.
561	31,000	71,000	32.5	27.4		.36*,	.29	Light yellow.
566	26,500	65,500	32.5	27.4		.32,	.33*	Light yellow; oblique.
583	23,500	51,500	14.0	13.2		.12,	.16*	Light and lemon yellow.
596	23,000	55,000	21.5	20.5		.19,	.24*	Do.
614	34,000	66,000	12.5	20.5		.14*,	.11	Light yellow; gray spot.
621	35,500	74,000	21.0	20.5		.20,	.22*	Light yellow.
623	32,500	72,500	31.0	30.7		.34*,	.28	Do.
628	34,500	74,000	22.5	23.9		.24*,	.21	Do.

547	28,500	56,000	9.5	13.2	.11*, .08	Light and lemon yellow.
667	30,500	69,500	27.0	28.9	.26*, .28*	Light yellow.
683	21,000	57,000	28.5	28.9	.24*, .23	Do.
685	20,500	50,500	12.0	16.9	.14*, .10	Do.
675	29,000	66,500	19.5	20.5	.21*, .18	Do.
961	21,500	58,000	23.0	28.9	.26*, .20	Do.
698	20,500	55,500	15.5	20.5	.14, .17*	Do.
737	28,500	54,000	7.0	9.5	.06, .08*	Lavender and lemon yellow.
740	26,000	47,500	6.5	9.5	.08*, .05	Lavender; lemon yellow spots.
745	19,500	47,000	10.0	13.2	.13*, .07	Light yellow; spongy.
741	21,500	58,000	16.5	20.5	.19*, .14	Lavender.
749	31,000	68,000	18.0	28.9	.20*, .16	Light yellow.
761	19,500	40,500	6.0	9.5	.09*, .03	Light and lemon yellow.
762-2	20,500	41,000	8.5	13.2	.05, .12*	Do.
794	28,000	44,800	5.0	9.2	.08*, .02	Lavender and lemon color.
798	20,500	57,500	20.0	27.4	.23*, .17	Light yellow.
800	21,500	61,500	13.0	16.9	.13, .13*	Light yellow and lemon color.
802	18,000	86,000	27.0	28.9	.26*, .28*	Golden yellow.
817	20,500	56,000	14.0	16.9	.16*, .12	Lavender and lemon yellow.
848	26,000	56,500	15.5	16.9	.12, .19*	Lemon yellow.
856	28,000	50,500	9.0	13.2	.11*, .07	Light yellow.
861	22,000	57,000	14.0	16.9	.11, .17*	Lavender and light yellow.
862	22,000	48,000	7.5	9.5	.10*, .05	Light and lemon yellow.
869	19,000	57,000	17.5	28.9	.17, .20*	Light yellow.
876	21,500	58,000	13.0	20.5	.11, .15*	Light yellow and lemon color.
889	19,500	48,000	8.5	13.2	.05, .12*	Light yellow; lemon yellow spots.
915	22,000	42,000	5.0	9.5	.03, .07*	Do.
942	22,000	58,500	16.5	20.5	.14, .19*	Light and lavender yellow.
955	19,000	39,000	6.5	9.5	.08*, .05	Light lemon yellow.
956	21,000	27,000	0.	0.	.00, .00	Lemon yellow.
955	20,000	61,000	25.0	27.4	.23, .27*	Light yellow; dark green spot.
978	21,000	52,500	8.0	13.2	.10*, .06	Lavender and lemon yellow.
956	21,000	55,500	14.0	20.5	.16*, .12	Light and lemon yellow.
985	21,000	41,000	5.0	13.2	.07*, .03	Do.
1086	24,000	61,000	19.0	27.4	.21*, .17	Do.
1121	26,000	60,500	18.5	13.2	.12, .15	Light yellow.
1142	22,000	35,500	18.0	27.4	.17, .19*	Uniform light yellow.
1217	19,000	56,000	14.0	20.5	.15*, .13	Light yellow; vesicular.
1251	29,000	67,000	12.5	16.9	.14*, .11	Light lavender and lemon yellow.
1294	37,500	81,500	15.0	20.5	.16*, .14	Light yellow.
1316	9,000	9,500	0.	0.	.00, .00	Golden yellow.
1316	13,000	22,500	0.	0.	.00, .00	Lemon yellow; spongy.
1322-1	19,500	38,000	26.0	30.7	.23, .29*	Light golden yellow.
1316-8	14,500	32,500	27.0	30.7	.23, .31*	Irregular; lemon yellow.
1331	32,000	75,500	21.5	27.4	.20, .23*	Uniform; light yellow.
1356	17,000	31,500	9.0	9.5	.07, .11	Blowhole.
1375	.....	41,000	20.0	27.4	.23*, .17	Dark yellow; blowholes.
1372-2	.....	22,000	6.5	5.7	.08, .10*	Dark, greenish yellow.
1373	31,000	50,200	5.0	6.8	.02, .08*	Lavender and lemon-yellow patches.
1378	27,000	74,500	22.0	27.4	.20, .24*	Uniform light yellow.
1373-2	28,000	75,500	20.5	23.9	.22*, .19	Do.

Bronze—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

10-INCH DISAPPEARING CARRIAGES—Continued.

Marks and descriptions.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
1380-2	.....	45,000	31.0	30.7	.31, .31*	Unform llight yellow.
1381	35,000	81,000	16.0	20.5	.14, .18*	Light golden yellow.
1372-2	.....	44,500	28.5	27.4	.37*. .20	Light yellow.
1376	31,000	47,400	4.0	6.8	.01, .07*	Lavender and lemon yellow.
1383-2	.....	44,000	26.0	20.5	.26, .26	Lavender and light yellow.
1392	20,000	62,000	20.5	27.4	.21*, .20	Light yellow.
1393	.....	59,500	16.0	20.5	.15, .17*	Light lemon yellow.
12-INCH DISAPPEARING CARRIAGES.						
21-603	65,560	72,720	21.3	31.2	.06, .45*, .11	Light yellow; oblique.
245	23,000	73,000	19.5	28.9	.17, .22*	Light yellow.
247	18,500	57,000	24.0	27.4	.21, .27*	Do.
419	20,200	43,840	10.0	18.2	.11*, .09	Light yellow; spongy spot.
435	22,500	56,000	16.5	20.5	.14, .19*	Light yellow.
500	23,500	51,500	11.5	13.2	.15*, .08	Light and lemon yellow.
506	22,500	40,000	12.5	16.9	.10, .15*	Lemon yellow and lavender.
578	22,500	57,000	23.5	27.4	.27*, .20	Light yellow; irregular.
718	22,500	51,500	14.5	20.5	.13, .16*	Light yellow.
1166	20,500	45,500	41.0	37.1	.38, .44*	Uniform light yellow.
1180	20,500	46,500	30.0	27.4	.31*, .29	Do.
1401	.....	57,000	18.0	20.5	.16, .20*	Lem on and light yellow
12-INCH MORTAR CARRIAGES.						
553	32,000	70,000	26.0	27.4	.25, .27*	Light yellow.
658	32,000	69,000	18.0	20.5	.15, .21*	Do.
660	28,500	62,500	15.0	20.5	.17*. .13	Light and lemon yellow.

MANGANESE BRONZE INGOTS.

180	27,000	78,500	27.5	34.0	.25, .30*	Light yellow.
PMB	30,500	79,000	30.5	30.7	.30*, .31*	Do.
3	32,000	78,000	35.0	46.2	.40*, .30	Light yellow; silky.
3-2	29,000	74,000	16.0	20.5	.15, .17*	Light yellow.
4PMB	34,000	81,000	27.0	30.7	.27*, .27*	Do.
	31,000	77,000	31.5	30.7	.30*, .33*	Do.
PO1755-1	31,000	77,500	31.0	34.0	.32*, .30*	Uniform light yellow.

LYLE LIFE-SAVING GUN.

22B	21,600	64,200	33.0	31.6	.32, .34*	Light yellow.
22M	21,000	58,200	20.0	23.0	.19, .21*	Do.
22MS	20,400	64,400	32.5	29.4	.36*, .29	Do.

FROM BUILDERS IRON FOUNDRY.

PL1	24,400	72,200	29.0	29.4	.30*, .28*	Uniform light yellow.
PL2	34,400	69,800	30.0	29.4	.29, .31*	Light yellow.
3	30,600	72,400	28.0	29.4	.27, .29*	Pale yellow.
PL4	32,600	72,000	26.0	27.4	.29*, .23	Light yellow.
PL5	33,000	73,600	27.0	27.4	.33*, .21	Do.

MISCELLANEOUS.

1 experimental	16,330	66,840	27.0	26.0	.27*, .27*	Light yellow.
4 experimental	32,000	69,000	18.5	16.9	.11, .16*	Do.
Alloy from Frankford Arsenal	19,000	25,500	1.0	0.0	.00, .02*	Drab color; brilliant green facets.
569 rammer coupling	27,500	50,500	10.5	13.2	.14*, .07	Light and lemon yellow.
1311 rammer coupling	19,000	62,500	20.0	27.4	.18, .22*	Light yellow; silky.
Experimental	.....	15,200	1.5	6.8	.00, .03*	Lemon yellow.

BRONZE SPECIMEN FOR COMPARISON OF TESTING MACHINE AT WORKS OF THE DRIGGS-SEABURY ORDNANCE CORPORATION.

D. S. O	34,000	51,400	29.0	35.6	.32*, .26	Light yellow; fine silky.

BRONZE.

ELONGATION TESTS.

TENSILE TESTS OF SPECIMENS FROM BRONZE FOR 10-INCH DISAPPEARING CARRIAGES, MODEL 1901, CAST AT WATERTOWN ARSENAL.

No. 8052.

Counter recoil buffer.
Bronze No. 4.
Marks, 266.
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	.....	
10,000	.0011	.....	
15,000	.0019	.....	
20,000	.0030	.....	
25,000	.0046	.....	
26,000	.0049	.....	
27,000	.0052	.....	
28,000	.0055	.....	
29,000	.0059	.....	
30,000	.0068	.0015	
31,000	.0065	.....	
32,000	.0069	.....	
33,000	.0074	.....	Elastic limit.
34,000	.0080	.....	
35,000	.0092	.....	
36,000	.0100	.....	
37,000	.0110	.....	
38,000	.0123	.....	
39,000	.0137	.....	
40,000	.0157	.0087	
41,000	.0178	.....	
42,000	.0202	.....	
43,000	.0217	.....	
44,000	.0263	.....	
45,000	.0289	.....	
46,000	.0330	.....	
47,000	.0352	.....	
48,000	.0418	.....	
49,000	.0462	.....	
50,000	.0530	.0437	
71,000	.....	.....	Tensile strength.
0	.35	.....	= 17.5 per cent elongation in 2".

Elongation of inch sections, ".21*, ".14.
Diameter at fracture, ".45; area, .1590 square inch.
Contraction of area, 20.5 per cent.
Appearance of fracture, light yellow.

TENSILE TESTS OF PARSONS' MANGANESE BRONZE.

Bronze melted at Watertown Arsenal and cast into bar of tapering form, $1\frac{5}{8}$″ square at smaller end and 2″ square at larger by 15″ long.

No. 8055.

First specimen.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0019	0.	
4,000	.0027	.....	
5,000	.0033	.0001	
6,000	.0041	.....	
7,000	.0049	.0001	
8,000	.0057	.....	
9,000	.0063	.....	
10,000	.0071	.0002	
11,000	.0079	.....	
12,000	.0088	.0002	
13,000	.0097	.....	
14,000	.0103	.....	
15,000	.0112	.0004	
16,000	.0121	.....	
17,000	.0131	.0008	
18,000	.0144	.....	
19,000	.0155	.....	
20,000	.0167	.0016	
21,000	.0180	.....	
22,000	.0190	.0022	
23,000	.0205	.....	
24,000	.0220	.....	
25,000	.0234	.0038	
26,000	.0248	.....	
27,000	.0265	.0049	
28,000	.0282	.....	
29,000	.0302	.....	
30,000	.0326	.0078	
31,000	.0340	.....	
32,000	.0372	.0106	
33,000	.0398	.....	
34,000	.0433	.....	
35,000	.0481	.0180	
36,000	.0510	.....	
37,000	.0570	.0252	
38,000	.0632	.....	
39,000	.0714	.....	
40,000	.0810	.0459	
41,000	.0908	.....	
42,000	.1041	.0669	
43,000	.1179	.....	
44,000	.1348	.....	
45,000	.1558	.1148	
46,000	.1650	.....	
47,000	.....	.....	Tensile strength.
0	.22	.....	= 2.2 per cent elongation in 10″.

Elongation of inch sections: ″.02, ″.01, ″.01, ″.02, ″.01, ″.02, ″.02, .02, ″.00, ″.09*.
Diameter at fracture, 1″.08; area, .917 square inch.
Contraction of area, 8.3 per cent.
Fractured 1″ from the neck.
Appearance of fracture, light yellow, in part lemon yellow.

No. 8056.

Second specimen.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	.....	
3,000	.0014	0.	
4,000	.0020	.....	
5,000	.0029	0.	
6,000	.0036	.....	
7,000	.0042	0.	
8,000	.0049	.....	
9,000	.0057	.....	
10,000	.0065	0.	
11,000	.0071	.....	
12,000	.0079	0.	
13,000	.0089	.....	
14,000	.0097	.....	
15,000	.0106	.0001	
16,000	.0112	.....	
17,000	.0125	.0004	
18,000	.0135	.....	
19,000	.0147	.....	
20,000	.0158	.0011	
21,000	.0168	.....	
22,000	.0181	.0019	
23,000	.0195	.....	
24,000	.0210	.....	
25,000	.0230	.0033	
26,000	.0239	.....	
27,000	.0258	.0047	
28,000	.0272	.....	
29,000	.0293	.....	
30,000	.0317	.0072	
31,000	.0332	.....	
32,000	.0360	.0100	
33,000	.0388	.....	
34,000	.0421	.....	
35,000	.0465	.0171	
36,000	.0490	.....	
37,000	.0560	.0249	
38,000	.0612	.....	
39,000	.0685	.....	
40,000	.0790	.0440	
41,000	.0878	.....	
42,000	.1010	.0640	
43,000	.1160	.....	
44,000	.1319	.....	
45,000	.1503	.1100	
46,000	.1630	.....	
47,000	.1890	.1465	
48,000	.....	.....	Tensile strength.
0	.26	.....	= 2.6 per cent elongation in 10″.

Elongation of inch sections: ″.02, ″.01, ″.02, ″.02, ″.01, ″.03, ″.02, ″.04, ″.06*, ″.03.

Diameter at fracture, 1″.08; area, .917 square inch.

Contraction of area, 8.3 per cent.

Fractured 1″.93 from the neck.

Appearance of fracture, light and lemon yellow, with patch of golden yellow.

TENSILE TEST OF TOBIN BRONZE FOR 5-INCH BARBETTE CARRIAGE, FROM WATERVLIET ARSENAL.

No. 8061.

Counter recoil buffer.
Marks, 3.
Diameter, 1".129.
Sectional area, 1 square inch.
Gauged length, 3".

Applied loads, per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0014	0.	
15,000	.0025	0.	
20,000	.0037	0.	
25,000	.0049	0.	
30,000	.0061	.0001	
31,000	.0065	.....	
32,000	.0067	.....	
33,000	.0071	.....	
34,000	.0077	.....	
35,000	.0084	.0009	
36,000	.0090	.....	
37,000	.0098	.....	
38,000	.0112	.....	
39,000	.0124	.....	
40,000	.0145	.0054	
41,000	.0165	.....	
42,000	.0201	.....	
43,000	.0251	.....	
44,000	.0313	.....	
45,000	.0407	.0286	
47,000	.0650	.....	
48,000	.0839	.....	
49,000	.1005	.....	
50,000	.1239	.1088	
61,400	.....	.....	Tensile strength.
0	1.21	.....	=40.3 per cent elongation in 3".

Elastic limit not well defined.
Elongation of inch sections: ".29, ".70*, ".22.
Diameter at fracture, ".75; area, .442 square inch.
Contraction of area, 55.8 per cent.
Fractured near middle of length of stem.
Appearance of fracture, light yellow, fine silky. Fine seam along surface of stem.

STEEL FOR COMPARISON OF TESTING MACHINES.

STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT WORKS OF S. R. CARR & CO., BALTIMORE, MD., FROM THE DETRICK & HARVEY MACHINE COMPANY.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per cent.*		
1 WA..	.505	.20	48,000	94,200	20.0	34.0	.24*, .16	Silky.
2 WA..	.505	.20	43,000	93,500	18.5	30.7	.24*, .13	Do.
3 WA..	.505	.20	45,000	91,500	17.5	30.7	.24*, .10	Do.
4 WA..	.505	.20	52,500	98,900	20.5	34.0	.28*, .13	Fine granular and silky.

STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT WORKS OF C. H. CONDREY MACHINE COMPANY.

1.....	.505	.20	73,000	85,500	17.5	51.9	.27*, .08	Fine silky; cup-shaped.
2.....	.505	.20	74,500	85,500	16.5	51.9	.25*, .08	Do.
3.....	.505	.20	75,000	85,500	18.0	51.9	.18*, .18*	Do.

STYRIAN STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT WATERVLIET ARSENAL.

1.....	.505	.20	103,000	134,500	19.5	49.1	.27*, .12	Fine silky; cup-shaped.
2.....	.505	.20	107,000	136,500	17.5	34.0	.20*, .15*	Do.
4.....	.505	.20	107,000	139,500	18.0	30.0	.16*, .20*	Do.

STEEL SPECIMEN FOR COMPARISON OF TESTING MACHINE AT WORKS OF THE DRIGGS-SEABURY ORDNANCE CORPORATION.

DS 7 ...	.505	.20	59,000	105,500	21.5	49.1	.12, .31*	Fine silky.

STEELS, MISCELLANEOUS.

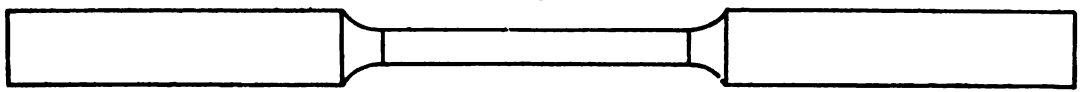
3-Inch Field Carriages.

TENSILE TESTS OF THREE LONGITUDINAL SPECIMENS, TAKEN OUT SIDE BY SIDE FROM A SAMPLE 3″ BY ¾″ IN CROSS-SECTION DIMENSIONS, OF STEEL FOR USE IN THE CONSTRUCTION OF SIGHTS AND QUADRANTS, RECEIVED FROM FRANKFORD ARSENAL.

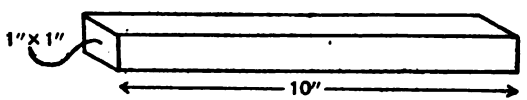
Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 8″.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″	
.505	.20	40,500	70,100	28.0	55.0	.15, .26, .43*	Fine silky.
.506	.20	45,500	71,000	27.0	50.0	.15, .30*, .36*	Do.
.497	.194	47,420	74,230	24.0	43.3	.37*, .21, .14	Do.

Anchor Bolts for Gun Carriages.

Tension specimens.



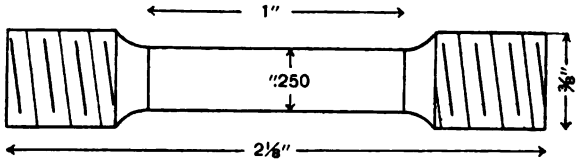
Bending specimens.



Description.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.	Bending test.
	Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per cent.*	" " "		
1¼-inch bolt from U. S. Engineer Corps, Boston.	1.009	.80	46,750	63,875	31.1	62.5	.21, .25, .29, .40, .65*, .27, .24, .18	Silky	Bent through 180° and closed down upon itself without fracture on the tension side. A shearing fracture developed on the compression side.
1¼-inch bolt from U. S. Engineer Corps, Boston.	1.129	1.00	39,500	54,280	36.5	67.0	.20, .28, .38, .88*, .34, .31, .29, .24	do	Bent through 180° and closed down upon itself without fracture.
Anchor bolt for 6-inch gun platform for the Engineer Corps, U. S. Army.	1.129	1.00	41,600	63,800	27.0	47.0	.18, .22, .31, .56*, .36, .23	Silky gray, small circular spots of lighter colored metal.	Bent cold 180° without fracture. In closing down, shearing fractures developed on the inside of the bend. The metal did not fracture on its tension side.

TENSILE TESTS OF THE METAL FROM PART OF A COUNTER-RECOIL SPRING FOR 3-INCH EXPERIMENTAL LONG-RECOIL FIELD CARRIAGE, RECEIVED FROM SANDY HOOK PROVING GROUND.

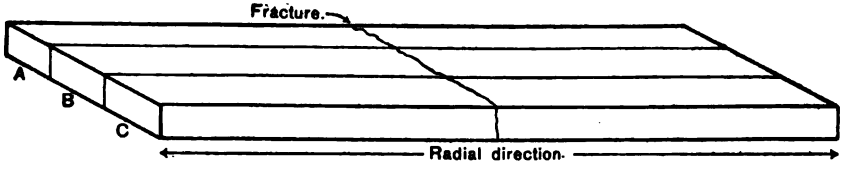
Coil straightened hot and metal then annealed.



Diameter.	Sectional area.	Elastic limit: Total.	Elastic limit: Per square inch.	Tensile strength. Total.	Tensile strength. Per square inch.	Elongation in 1".		Contraction of area.	Appearance.
Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per ct.*	*Per ct.*	
.250	.0491	3,600	73,320	6,210	126,480	.20	20.0	42.2	Fine silky; trace of granulation.
.250	.0491	3,690	75,150	6,200	126,270	.21	21.0	42.2	Fine silky.

STREAKED HOOP NO. 5388, RING 1, SEGMENT 7.

TENSILE SPECIMENS CUT FROM A RADIAL STRIP.



Marks.	Dimensions. Width.	Dimensions. Thickness.	Sectional area.	Tensile strength. Total.	Tensile strength. Per square inch.	Elongation in 1".	Appearance of fractures.
	Inch.	*Inch.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Per cent.*	
A	.296	.197	.0581	4,900	84,320	5.0	Granular.
B	.438	.198	.0867	6,600	76,120	4.0	Do.
C	.434	.198	.0859	6,900	80,300	5.0	Do.

REMARKS.—A light-colored streak, extending nearly across the strip in both width and thickness, marked the line of fracture in the three specimens. There were several streaks present, fracture occurring along the principal one. Gauged length of 1" was established across principal streak.

METAL FROM 62-INCH OCTAGONAL CARBON STEEL INGOT.

TENSILE TESTS MADE ON UNFORGED BARS AFTER TREATMENT BY HEATING AND QUENCHING.

Marks.	Description.	Diameter.	Sectional area.	Tensile strength.		Position and appearance of fracture.
				Total.	Per square inch.	
		Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	
H	Heated white hot, quenched in oil.	.558	.245	29,100	118,780	Fractured ".8 from the neck. Granular, in part dull gray.
I	Heated white hot, quenched in brine.	.602	.285	4,200	14,740	Fractured 1" from the neck. Granular, 60 per cent; reddish brown, 40 per cent. Fractured at a crack in stem.
P	Heated low yellow, quenched in oil.	.557	.244	25,300	103,690	Fractured 2" from the neck. Fine granular with irregular surface; 10 per cent medium coarse granular.
Q	Heated bright yellow, quenched in oil.	.616	.298	32,100	107,720	Fractured 1".6 from the neck. Fine granular.

STEEL WIRE.

TENSILE TESTS OF BRAZED AND ELECTRICALLY WELDED SQUARE STEEL WIRE FOR 6-INCH WIRE-WRAPPED GUN.

Specimens received from Watervliet Arsenal.
Size of wire, ".102 ± by ".101 ±.

BRAZED SAMPLES, SCARF JOINTS.

No. of sample.	Tensile strength.	No. of sample.	Tensile strength.	No. of sample.	Tensile strength.	No. of sample.	Tensile strength.	No. of sample.	Tensile strength.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*
1	1,440	11	1,380	21	1,370	31	1,340	41	1,420
2	1,380	12	990	22	1,040	32	1,380	42	1,390
3	1,460	13	1,360	23	1,360	33	700	43	1,410
4	1,410	14	1,320	24	1,380	34	1,390	44	1,390
5	1,350	15	1,010	25	1,320	35	1,370	45	1,310
6	1,290	16	1,370	26	1,010	36	1,370	46	1,330
7	1,100	17	1,440	27	1,320	37	1,110	47	1,400
8	1,400	18	1,480	28	1,360	38	1,320	48	1,430
9	1,430	19	1,400	29	1,360	39	1,330	49	1,460
10	1,480	20	1,420	30	1,380	40	1,310	50	1,410

Fractures: Nos. 7, 12, 15, 22, 26, 33, and 37 parted along the scarf. Others fractured at or near end of scarf joint.

ELECTRICALLY WELDED SAMPLES.

No. of sample.	Tensile strength.	No. of sample.	Tensile strength.	No. of sample.	Tensile strength.	No. of sample.	Tensile strength.	No. of sample.	Tensile strength.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*
1	1,100	11	1,920	21	720	31	1,540	41	1,010
2	1,480	12	1,200	22	500	32	1,620	42	1,020
3	1,820	13	1,950	23	1,510	33	1,890	43	1,970
4	1,210	14	1,100	24	1,630	34	1,120	44	2,020
5	1,020	15	1,820	25	1,100	35	1,860	45	950
6	1,910	16	1,880	26	1,820	36	950	46	1,210
7	1,020	17	1,800	27	2,010	37	1,620	47	520
8	1,500	18	1,500	28	1,580	38	1,890	48	1,020
9	1,320	19	1,940	29	1,810	39	980	49	1,650
10	1,760	20	1,650	30	1,320	40	1,320	50	1,790

Fractures: Nos. 22 and 39 had blue-black spot on fractured surface of each. Nos. 3, 16, 19, 43, and 44 broke outside the weld, with a silky fracture. All others broke at the weld, with granular fractures.

Tensile tests of steel wire for hooks for safety lanyard device.

Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Appearance of fracture.
		Total.	Per square inch.	Total.	Per square inch.	
Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
.10	.0079	(a)	(a)	1,640	207,590	Silky.
.125	.0123	(a)	(a)	1,360	110,570	Do.
.134	.0141	2,350	166,670	2,620	185,820	Do.

a Coincident with tensile strength.

TENSILE TESTS OF SWIVELS FOR BUOY CHAINS FOR THE UNITED STATES LIGHT-HOUSE ESTABLISHMENT, THIRD DISTRICT, TOMPKINSVILLE, N. Y.

Description.	Tensile strength.	Parted.
	Pounds.	
2-inch swivel	196,000	Eye of bail in front of pin.
1¼-inch swivel	189,200	Under the head of the swivel stem.
1¼-inch swivel	110,000	Sheared the pin.
2-inch light vessel swivel	169,900	Fractured one end link at the welded end, parting along the scarf. Swivel uninjured.
		Load again applied, connecting swivel to testing machine by means of a loop fixture.
	207,000	The other end link fractured at the weld. Swivel was not fractured. The stem was free to turn through an angle of about 80 degrees.

HELICAL SPRINGS.

COUNTER RECOIL SPRINGS FOR 6-INCH BARBETTE GUN CARRIAGES.

COMPRESSION TESTS.

Eight springs (4 outer and 4 inner) from The W. D. Gibson Company.

DESCRIPTION OF SPRING NO. 1.

	Outer spring.	Inner spring.
Free height ..... inches..	28.40	21.43
Exterior diameter ..... do....	7.64	4.3
Size of wire ..... do....	1.24	1.02
Distance between coils ..... do....	1.05	.35
Weight ..... pounds..	90.00	36.00

TESTS OF THE SPRINGS.

OUTER SPRINGS.

Spring number.	Free height.	Closed height.	Free height after being closed down 64 hours.	Free height after loading 100 times.
	Inches.	*Inches.*	*Inches.*	*Inches.*
1	28.40	16.70	28.00	27.52
2	27.75	16.47	27.25	26.85
3	27.80	16.63	27.63	27.18
4	28.00	16.64	27.68	27.40

INNER SPRINGS.

1	21.43	15.90	20.94	20.70
2	21.04	15.85	20.76	20.71
3	21.17	16.10	20.79	20.63
4	20.87	15.90	20.47	20.32

After having been closed down 64 hours and loaded 100 times the springs tested as follows:

OUTER SPRINGS.

Marks.	Free height.	Load at 29″.125.	Height at 5,000 pounds.	Height at 11,000 pounds.	Load at 17″.50.	Height at 5,000 pounds.	Load at 29″.125.	Final free height.
	Inches.	*Pounds.*	*Inches.*	*Inches.*	*Pounds.*	*Inches.*	*Pounds.*	*Inches.*
1	27.52	4,732	22.88	17.36	10,795	22.55	4,480	27.55
2	26.85	3,990	22.21	16.71	9,920	21.87	3,650	27.08
3	27.18	4,800	22.96	17.50	11,000	22.71	4,596	27.41
4	27.40	4,590	22.74	17.17	10,545	22.44	4,243	27.33

INNER SPRINGS.

Marks.	Free height.	Load at 19″.375.	Height at 5,000 pounds.	Height at 11,000 pounds.	Load at 17″.05.	Height at 5,000 pounds.	Load at 19″.875.	Final free height.
	Inches.	*Pounds.*	*Inches.*	*Inches.*	*Pounds.*	*Inches.*	*Pounds.*	*Inches.*
1	20.70	3,530	18.90	16.65	9,940	18.60	2,910	20.55
2	20.71	4,045	19.08	17.08	10,940	18.93	3,600	20.78
3	20.68	3,470	18.89	16.67	10,090	18.62	2,912	20.65
4	20.32	2,870	18.68	16.46	9,432	18.36	2,290	20.35

Axes of springs were not straight.

Springs received from the Railway Steel Spring Company, Philadelphia, Pa.

DESCRIPTION.

	Outer spring (117).	Inner spring (124).
Free height ..... inches..	28.80	21.82
Exterior diameter ..... do....	7.60	4.28
Diameter of wire ..... do....	1.24	1.00
Distance between coils ..... do....	1.08	.32
Weight ..... pounds..	90.00	36.5

TESTS OF THE SPRINGS.

OUTER SPRINGS.

Marks.	Free height.	Load at 23″.125.	Height at 5,000 pounds.	Height at 11,000 pounds.	Load at 17″.50.	Height at 5,000 pounds.	Load at 23″.125.	Final free height.
	Inches.	*Pounds.*	*Inches.*	*Inches.*	*Pounds.*	*Inches.*	*Pounds.*	*Inches.*
117	28.80	6,050	24.12	17.94	11,420	23.06	4,960	28.28
—	28.90	6,260	24.34	18.26	11,750	23.38	5,260	28.60

No. 117 was practically closed down with 13,100 pounds, at height of 16″.86.

No. — was practically closed down with 13,100 pounds, at height of 16″.77.

INNER SPRINGS.

Marks.	Free height.	Load at 19″.375.	Height at 5,000 pounds.	Height at 11,000 pounds.	Load at 17″.05.	Height at 5,000 pounds.	Load at 19″.375.	Final free height.
	Inches.	*Pounds.*	*Inches.*	*Inches.*	*Pounds.*	*Inches.*	*Pounds.*	*Inches.*
124	21.82	6,400	19.94	17.50	12,270	19.59	5,570	21.70
138	22.04	6,630	20.07	17.38	11,650	19.50	5,300	21.84

No. 124 was practically closed down at height of 17″.05.

No. 138 closed down with 12,480 pounds, at height of 16″.73.

DESCRIPTION OF SPRING NO. 1.

	Outer spring.	Inner spring.
Free height ..... inches..	27.60	21.04
Exterior diameter ..... do...	7.61	4.22
Diameter of wire ..... do...	1.24	1.00
Distance between coils ..... do...	.90	.27
Weight ..... pounds..	91.5	37.00

TESTS OF THE SPRINGS.

OUTER SPRINGS.

Marks.	Free height.	Load at 23″.125.	Height at 5,000 pounds.	Height at 11,000 pounds.	Closed.		Load at 17″.50.	Height at 5,000 pounds.	Load at 23″.125.	Final free height.
					Height.	Load.				
	Inches.	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*	*Inches.*	*Pounds.*	*Inches.*
1	27.60	4,836	22.96	16.85	16.65	13,520	9,828	21.96	3,848	27.38
2	27.38	4,680	22.84	17.05	16.72	13,832	9,984	22.10	3,981	27.30
3	27.54	4,732	22.86	16.94	16.72	13,624	9,880	21.94	3,796	27.40
4	27.62	4,784	22.89	17.27	16.80	15,184	9,932	21.96	3,827	27.40

INNER SPRINGS.

Marks.	Free height.	Load at 19″.375.	Height at 5,000 pounds.	Height at 11,000 pounds.	Closed.		Load at 17″.05.	Height at 5,000 pounds	Load at 19″.375.	Final free height.
					Height.	Load.				
	Inches.	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*	*Inches.*	*Pounds.*	*Inches.*
1	21.04	4,160	19.04	16.68	16.62	12,688	8,736	18.75	3,057	20.87
2	21.14	4,368	19.11	16.84	16.79	12,584	9,152	18.68	3,307	21.03
3	21.29	5,000	19.37	17.00	16.78	12,792	10,244	18.99	4,056	21.13
4	21.15	4,472	19.13	16.84	16.78	12,792	9,297	18.68	3,359	21.00

COUNTER RECOIL SPRINGS FOR 75-MILLIMETER MOUNTAIN GUN CARRIAGE.

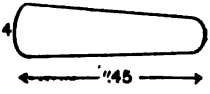
Test made for the Ordnance Department, U. S. Army.

English spring, received at Watertown Arsenal with carriage of English manufacture.

DIMENSIONS.

Free height (horizontal position)	inches..	25.43
Exterior diameter	do....	2.05
Interior diameter	do....	1.15
Pitch of coils	inch..	.56
Number of coils		45¼

Size of ribbon .....



Weight	pounds..	3.34

COMPRESSION TEST.

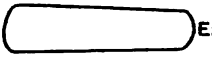
Ascending stresses:		
Free height (vertical position)	inches..	25.34
Height at load of 92 pounds	do....	21.1
Height at load of 376 pounds	do....	7.0
Closed height	do....	6.35
Descending stresses:		
Height at load of 360 pounds	do....	7.0
Height at load of 72 pounds	do....	21.1
Free height	do....	25.17

SPRING MADE BY THE W. D. GIBSON COMPANY, CHICAGO, ILL.

This spring had previously been closed down sixty hours.

DIMENSIONS.

Free height (horizontal position after compression test)	inches..	30.20
Exterior diameter	do...	2.10
Interior diameter	do....	1.09
Pitch of coils	inch..	.57
Number of coils		53

Size of ribbon..... Int. ".11  Ext. ".09

".505

Weight	pounds..	3.58

COMPRESSION TEST.

Ascending stresses:		
Free height (vertical position)	inches..	30.26
Height at load of 118 pounds	do....	21.1
Height at load of 294 pounds	do....	7.0
Closed height	do....	6.40
Descending stresses:		
Height at load of 285 pounds	do....	7.0
Height at load of 101 pounds	do....	21.1
Free height	do....	29.97

TENSILE TESTS OF METAL FROM THE SPRINGS.

Springs straightened hot and metal then annealed.

Make of spring.	Dimensions.			Elastic limit.		Tensile strength.		Elongation in 2".		Cont. of area.	Appearance of fracture.
	Width.	Thickness.	Sec. area.	Total.	Per square inch.	Total.	Per square inch.				
	Inch.	*Inch.*	*Sq. in.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*In.*	*Per ct.*	*Per ct.*	
English ..	.441	.117	.0516	3,800	73,640	7,020	136,050	.04	2.0	10.5	Granular.
Gibson ...	.465	.093	.0432	2,300	53,240	4,320	100,000	.15	7.5	30.3	Silky, 40 per cent; fine granular, 60 per cent.

COUNTER RECOIL SPRINGS FOR MORTAR CARRIAGES.

DESCRIPTION OF SPRINGS.

	7-inch mortar carriage, model 1896.	12-inch mortar carriage, model 1896.	
		Large spring.	Small spring.
Free height.....inches..	18.69	14.38	14.02
Exterior diameter.....do...	5.03	9.08	5.51
Interior diameter.....do...	3.65	5.54	3.01
Pitch of coils.....do...	1.53	2.83	1.88
Number of coils, full	13.00	4.5	6.50
Size of wire.....inches..	.69	1.77	1.25
Weight.....pounds..	19.00	86.25	35.50

COMPRESSION TESTS.

7-INCH MORTAR CARRIAGE, MODEL 1895.

Ascending stresses:		
Load at height of 15".....pounds..		1,250
Load at height of 9".5.....do....		4,140
Descending stresses:		
Load at height of 15".....do....		1,180
Final free height.....inches..		18.60

12-INCH MORTAR CARRIAGE, MODEL 1896.

	Large spring.	Small spring.
Ascending stresses:		
Load at height of 12″.25 ..... pounds..	14,700	9,900
Load at height of 9″.75[a] ..... do...	82,000	21,900
Descending stresses:		
Load at height of 12″.25 ..... do...	11,900	6,000
Final free height ..... inches..	14.30	13.70

[a] Spring was practically closed down at 48,000 pounds compression, at a height of 9″.90. Inequality in pitch causes some coils to make contact in advance of others.

TENSILE TESTS.

Springs straightened hot and metal then annealed.

Description.	Diameter.	Sec. area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 10″.	Contraction of area.	Elongation of inc ections.			Appearance of fracture.
	Inch.	*Sq. in.*	*Lbs.*	*Lbs.*	*Per ct.*	*Per ct.*	″	″	″	
7″ mortar carriage.	.66	.342	91,230	154,090	4.5	8.8	.04, .03, .04, .06.	.05, .05, .05,	.04, .03, .06,	Granular.
12″ mortar carriage, large spring.	1.74	2.378	58,450	114,380	4.3	6.8	.05, .04, .04, .04.	.05, .04, .04,	.05, .03, .05*,	Do.
12″ mortar carriage, small spring.	1.18	1.094	63,530	134,460	5.4	10.0	.07, .09*, .04, .03.	.06, .06, .03,	.08*, .05, .03,	Do.

12-INCH MORTAR CARRIAGE, MODEL 1896.

Two double coil springs from the Railway Steel Spring Company, New York.

DESCRIPTION OF SPRINGS.

	Outer spring. (*b*)	Inner spring.
Free height ..... inches..	14.50	13.60
Exterior diameter ..... do....	9.16	5.55
Diameter of wire ..... do....	1.74	1.24
Distance between coils ..... inch..	1.00	.60
Weight ..... pounds..	85.00	34.5

Each spring was closed down rapidly under steam hammer 100 times. Outer spring (*a*) was closed down and so remained 18 hours.

COMPRESSION TESTS OF THE SPRINGS.

Spring.	Load at height of 12".25.	Height when closed.	Final free height.
	Pounds.	*Inches.*	*Inches.*
Outer (*a*)	11,150	9 70	14.26
Outer (*b*)	12,870	9.75	14.29
Inner (*a*)	3,870	9.65	12.90
Inner (*b*)	8,000	9.47	13.18
Springs assembled and an outer and inner spring tested together:			
Outer (*a*)	16,840		
Inner (*b*)			
Outer (*b*)	15,700		
Inner (*a*)			

Elevating friction clutch spring.

SPECIFICATIONS.

Solid height to be 3".375, under load of 11,250 pounds.
Initial height to be 3".625, under load of 7,500 pounds.

DESCRIPTION OF SPRING.

Free height	inches..	4.20
Exterior diameter	do...	5.30
Size of wire	do...	1.12
Distance between coils	inch..	.50
Weight	pounds..	11.00

COMPRESSION TEST.

Load at height of 3".625	pounds..	10,060
Load at solid height of 3".46	do...	16,600
Releasing:		
Load at height of 3".625	do...	8,600

Compression Test of Tray Buffer Spring Manufactured at Watertown Arsenal.

DESCRIPTION OF SPRING.

Free height	inches..	4.65
Exterior diameter of coil	do...	2.58
Diameter of wire	inch..	.53
Distance between coils	do...	.25

COMPRESSION TEST.

Load at height of 4".25	pounds..	992
Load at height of 3".50	do...	3,120
Releasing:		
Load at height of 4".25	do...	801
Free height	inches..	4.68

10-inch Disappearing Carriage, Model 1896.

COMPRESSION TEST OF HELICAL SPRING FOR COUNTERBALANCE DEVICE.

Spring closed down 100 times, after which the dimensions were as follows:

Free height	inches..	15.05
Exterior diameter	do...	5.50
Diameter of wire	inch..	.85
Distance between coils	do...	.50
Weight	pounds..	27.00

COMPRESSION TEST.

Load at height of 11".75	pounds..	2,772

15-Pounder Driggs-Seabury R. F. Mounts.

Counter recoil springs received from Fort Warren.

DESCRIPTION OF THE SPRINGS.

	Outer springs.		Inner springs.	
	No. 1.	No. 2.	No. 1.	No. 2.
Free height ..... inches..	18.30	18.50	16.45	17.60
Exterior diameter..... do....	3.70	3.75	2.50	2.55
Size of wire ..... inch..	.55	.55	.39	.40
Distance between coils..... do....	.50	.53	.35	.36

COMPRESSION TESTS OF THE SPRINGS.

Outer springs:
No. 1—Load at height of 15"..... pounds.. 822
No. 2—Load at height of 15"..... do.... 862
Inner springs:
No. 1—Load at height of 14"..... do.... 444
No. 2—Load at height of 14"..... do.... 381

RESISTANCE OF JACKETED BULLETS WHEN FORCED THROUGH THE BORE OF A .30-CALIBER RIFLE BARREL.

First Series of Tests.

Jacketed bullets forced through .30-caliber rifle barrel.
New barrel received from Springfield Armory.
Regular bullets, ½″ bearing length.

FIRST BULLET.

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	0.	11 40 00	
60	.04	.008	11 41 00	
132	.10	.005	11 42 00	
280	.19	.008	11 43 00	
494	.28	.008	11 44 00	
680	.36	.007	11 45 00	
1,090	.41	.004	11 46 00	
1,239	.48	.006	11 47 00	Maximum resistance.
1,210	.51	.005	11 47 30	
1,186	.55	.....	.....	
1,142	.60	.004	11 49 30	
1,106	.65	.....	.....	
1,045	.70	.....	.....	
955	.80	.007	11 52 00	
865	.90	.....	.....	
842	1.00	.017	11 53 00	
797	1.20	.017	11 54 00	
790	1.40	.....	.....	
760	1.60	.....	.....	
760	1.80	.....	.....	
762	2.00	.....	.....	
772	2.50	.072	11 55 30	
812	3.00	.....	.....	
814	3.50	.167	11 56 00	
				Changed pistons.
781	4.00	.....	1 19 00	
746	5.00	.....	.....	
710	6.00	.....	.....	
698	7.00	.125	1 21 00	
698	8.00	.....	.....	
670	9.00	.....	.....	
670	9.50	.139	1 22 30	
				Changed pistons.
665	10.00	.....	1 32 00	
674	11.00	.....	.....	
686	12.00	.....	.....	
690	13.00	.125	1 34 00	
680	14.00	.....	.....	
675	15.00	.....	.....	
672	16.00	.....	.....	
635	17.00	.....	.....	
656	18.00	.....	.....	
626	19.00	.143	1 37 30	
602	20.00	.....	.....	
648	21.00	.....	.....	

First Series of Tests—Continued.

SECOND BULLET.

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	.....	2 7 00	
70	.02	.008	2 7 30	
100	.05	.005	2 8 00	
150	.10	.008	2 8 30	
200	.13	.....	.....	
300	.20	.006	2 10 00	
400	.24	.....	.....	
600	.30	.....	.....	
800	.38	.....	.....	
1,000	.43	.013	2 11 30	
1,100	.50	.....	.....	Maximum resistance.
1,124	.65	.....	.....	
900	.81	.016	2 13 30	
843	1.00	.....	.....	
820	1.50	.038	2 15 00	
790	2.00	.021	2 17 00	
764	2.50	.....	.....	
741	3.00	.....	.....	
741	3.50	.042	2 20 00	Changed pistons.
734	4.00	.....	2 26 00	
719	5.00	.083	2 27 00	
702	6.00	.055	2 28 30	
700	7.00	.083	2 29 30	
638	8.00	.083	2 30 30	
612	9.00	.083	2 31 30	
612	9.50	.....	.....	Changed pistons.
586	10.00	.....	2 37 00	
570	11.00	.083	2 38 00	
574	12.00	.....	.....	
542	13.00	.....	.....	
550	14.00	.250	2 39 00	
556	15.00	.....	.....	
566	16.00	.....	.....	
547	17.00	.....	.....	
577	18.00	.....	.....	
555	19.00	.119	2 42 30	
548	20.00	.....	.....	
627	21.00	.....	.....	

First Series of Tests--Continued.

THIRD BULLET.

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	.....	2 55 00	
70	.01	.....		
100	.03	.005	2 55 30	
150	.10	.....	.....	
200	.15	.....	.....	
300	.21	.....	.....	
400	.27	.013	2 57 00	
600	.35	.....	.....	
800	.41	.....	.....	
1,000	.44	.....	.....	
1,100	.47	.....	.....	
1,200	.50	.....	.....	
1,267	.53	.....	.....	Maximum resistance.
1,250	.59	.....	.....	
1,258	.72	.008	3 2 00	
1,130	.88	.....	.....	
1,095	1.00	.....	.....	
1,084	1.50	.033	3 4 00	
1,044	2.00	.....	.....	
1,002	2.50	.042	3 6 00	
1,006	3.00	.042	3 7 00	
961	3.50	.028	3 8 30	
				Changed pistons.
884	4.00	.....	3 15 00	
894	5.00	.083	3 16 00	
900	6.00	.....	.....	
920	7.00	.167	3 17 00	
862	8.00	.....	.....	
866	9.00	.....	.....	
860	9.50	.208	3 18 00	
				Changed pistons.
840	10.00	.....	3 23 00	
812	11.00	.....	.....	
790	12.00	.....	.....	
778	13.00	.....	.....	
782	14.00	.....	.....	
774	15.00	.....	.....	
760	16.00	.250	3 25 00	
721	17.00	.....	.....	
746	18.00	.....	.....	
704	19.00	.....	.....	
718	20.00	.333	3 26 00	
760	21.00	.....	.....	

Tests discontinued and barrel returned to Springfield Armory for firing.

First Series of Tests—Continued.

Same barrel returned from Springfield Armory after having been fired 3,500 rounds.

Regular bullets, ½″ bearing length.

FOURTH BULLET.

[First after firing.]

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	.....	3 1 00	2¾″ from end of barrel to base of bullet, or about ¼″ beyond cartridge case.
70	.25	.....	.....	
100	.30	.....	.....	
150	.37	.010	3 4 00	
200	.50	.....	.....	
300	.75	.021	3 5 30	
400	.96	.....	.....	
600	1.08	.....	.....	
800	1.20	.....	.....	
1,000	1.24	.....	.....	
1,100	1.26	.....	.....	
1,150	1.30	.010	3 10 00	
1,200	1.32	.....	.....	
1,300	1.33	.....	.....	
1,400	1.34	.....	.....	
1,500	1.40	.....	.....	
1,600	1.41	.....	.....	
1,700	1.41	.....	.....	
1,800	1.41	.....	.....	
2,000	1.41	.....	.....	
2,200	1.41	.002	3 15 00	Changed pistons.
2,400	1.41	.....	.....	
2,600	1.42	.....	3 23 00	
2,800	1.43	.....	.....	
3,000	1.44	.....	.....	
3,200	1.44	.....	.....	
4,000	1.46	.....	.....	
4,350	1.49	.....	.....	Maximum resistance.
3,200	1.50	.....	.....	
2,700	1.53	.....	.....	
2,900	1.60	.....	.....	
2,900	1.70	.008	3 32 00	
3,220	1.80	.....	.....	
2,910	1.90	.....	.....	
2,750	2.00	.....	.....	
2,980	2.50	.033	3 34 00	Changed pistons. The piston which was taken out required force to remove it.
3,650	2.60	.....	9 21 00	
3,050	3.00	.....	.....	
3,180	3.50	.038	9 23 00	Changed pistons.
3,500	3.60	.....	9 27 00	
2,960	4.00	.....	.....	
2,900	4.50	.....	.....	
2,800	5.00	.058	9 29 00	Changed pistons.
2,900	5.50	.....	9 34 00	
2,820	6.00	.....	.....	
2,500	6.50	.028	9 37 00	Changed pistons.
2,480	6.60	.....	9 47 00	
2,240	7.00	.....	.....	
2,180	7.50	.075	9 48 00	Changed pistons.
2,260	7.60	.....	9 52 00	
2,180	8.00	.....	.....	
2,080	8.50	.....	.....	
1,980	9.00	.047	9 54 30	Changed pistons.
1,980	9.50	.....	9 59 30	
1,820	9.50	.....	.....	
1,800	10.00	.....	.....	
1,800	11.00	.045	10 3 00	
1,560	12.00	.....	.....	
1,420	13.00	.067	10 5 30	Changed pistons.
1,300	13.10	.....	10 11 00	

First Series of Tests—Continued.

FOURTH BULLET—Continued.

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds	*Inches.*	*Foot.*	*h. m. s.*	
1,220	14.00	.....	.....	
1,250	15.00	.....	.....	
1,260	16.00	.....	.....	
1,250	17.00	0.081	10 15 00	
1,280	18.00	.....	.....	
1,180	19.00	.....	.....	
1,300	20.00	.250	10 16 00	
1,000	21.00	.....	.....	

The lead was forced through the jacket of the bullet, the conical point being detached from the cylindrical part of the jacket. The rear part of the jacket fell behind the base of the lead a distance of $\frac{1}{4}$" on one side of the bullet, and apparently got between the piston and the walls of the barrel, thereby increasing the frictional resistance.

FIFTH BULLET.

[Second after firing.]

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	.....	2 8 00	Bullet entered freely to a place where its base was $\frac{1}{4}$" beyond the forward end of the cartridge case.
70	.28	.....	.....	
100	.37	.....	.....	
150	.52	.....	.....	
200	.95	.026	2 11 00	
300	2.09	.063	2 12 30	
400	2.32	.....	.....	
445	2.50	.023	2 14 00	
				Changed pistons.
458	2.60	.....	2 19 00	
636	3.00	.017	2 21 00	
896	3.50	.....	.....	
1,118	4.00	.042	2 23 00	
1,306	5.00	.042	2 25 00	
1,690	6.00	.083	2 26 00	
1,866	6.50	.083	2 26 30	
				Changed pistons.
1,940	6.60	.....	2 34 00	
2,100	7.00	.033	2 35 00	
2,145	8.00	.....	.....	
2,320	9.00	.083	2 37 00	
2,430	10.00	.....	.....	
2,255	11.00	.056	2 40 00	
1,998	12.00	.....	.....	
1,927	12.50	.....	.....	
				Changed pistons.
2,220	12.52	.....	.....	
1,880	12.60	.....	2 56 00	
1,900	13.00	.....	.....	
1,820	14.00	.058	2 58 00	
1,795	15.00	.056	2 59 30	
1,789	16.00	.083	3 0 30	
1,910	16.50	.....	.....	
				Changed pistons.
2,100	16.52	.....	.....	
1,880	16.60	.....	3 9 00	
2,020	17.00	.....	.....	
2,060	18.00	.....	.....	
2,300	19.00	.....	.....	
2,430	20.00	.142	3 11 00	
				Changed pistons.
2,980	20.08	.....	.....	Maximum resistance.
2,000	20.40	.....	.....	
540	21.00	.....	.....	

Bullet showed marks of the rifling for a length of .″9.

First Series of Tests—Continued.

SIXTH BULLET.

[Third after firing.]

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	.....	9 8 00	
70	.20	.....	.....	
100	.28	.....	.....	
150	.40	.....	.....	
200	.59	.....	.....	
300	1.45	0.080	9 12 00	
400	2.00	.....	.....	
473	2.50	.044	9 14 00	
				Changed pistons.
664	2.51	.....	.....	
500	2.60	.....	11 0 00	
642	3.00	.022	11 1 30	
1,152	4.00	.056	11 3 00	
1,610	5.00	.....	.....	
2,310	6.00	.056	11 6 00	
2,290	6.50	.....	.....	
				Changed pistons.
2,100	6.52	.....	11 13 00	
2,320	6.60	.013	11 13 30	
2,468	7.00	.....	.....	
2,226	8.00	.....	.....	
2,745	9.00	.044	11 18 00	
3,620	10.00	.....	.....	Maximum resistance.
				Changed pistons.
3,500	10.02	.....	11 25 00	
3,460	10.10	.....	.....	
2,600	10.19	.....	.....	
2,420	11.00	.....	.....	
2,400	12.50	.069	11 28 00	
				Changed pistons.
2,500	12.58	.....	11 35 00	
2,080	13.00	.026	11 36 30	
2,180	14.00	.083	11 37 30	
2,210	15.00	.056	11 39 00	
				Changed pistons
2,300	15.02	.....	11 44 00	
2,000	15.10	.....	.....	
2,020	16.00	.....	.....	
2,000	17.00	.083	11 46 00	
2,100	17.50	.....	.....	
				Changed pistons.
2,040	17.60	.....	11 51 30	
1,900	18.00	.....	.....	
1,840	19.00	.....	.....	
1,980	20.00	.133	11 53 00	
700	21.00	.....	.....	

Bullet showed marks of the rifling for a length of ".95 to 1".00. The conical point of the jacket was ruptured circumferentially about .8 around the body. The metal of the jacket at the base of the bullet flowed over the end of the piston ".05 (maximum length of the thin fin).

SECOND SERIES OF TESTS.

Jacketed bullets forced through .30-caliber rifle barrel.
New barrel received from Springfield Armory.
Regular bullets, $\frac{1}{2}$-inch bearing length.

FIRST BULLET.

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	0.	9 43 00	
50	.07	.....	.....	
100	.11	.006	9 44 30	
150	.17	.....	.....	
200	.21	.006	9 46 00	
250	.25	.....	.....	
300	.28	.....	.....	
350	.30	.....	.....	
400	.34	.005	9 48 00	
500	.40	.....	.....	
600	.49	.....	.....	
700	.58	.....	.....	
800	.62	.012	9 50 00	
900	.71	.....	.....	
908	.79	.014	9 51 00	
836	.90	.....	.....	
790	1.00	.009	9 53 00	
792	1.10	.006	9 54 30	
804	1.30	.017	9 55 30	
840	1.50	.017	9 56 30	
970	2.00	.012	10 00 00	
1,002	2.50	.021	10 2 00	
1,100	3.00	.028	10 3 30	
1,190	3.14	.....	.....	
1,242	3.50	.012	10 7 00	Maximum resistance. Changed pistons.
1,015	4.00	.....	10 21 00	
1,030	4.50	.....	.....	
1,028	5.00	.083	10 22 00	
1,044	5.50	.....	.....	
1,060	6.00	.083	10 24 00	
1,036	6.50	.....	.....	
1,042	7.00	.042	10 26 00	
1,013	7.50	.....	.....	Changed pistons.
978	8.00	.....	11 24 00	
924	9.00	.056	11 25 30	
914	10.00	.056	11 27 00	
918	11.00	.167	11 27 30	
924	12.00	.167	11 28 00	
918	12.50	.....	.....	Changed pistons.
931	13.00	.....	11 39 00	
988	14.00	.083	11 40 00	
924	15.00	.067	11 41 15	
878	16.00	.067	11 42 30	
810	17.00	.083	11 43 30	
752	18.00	.083	11 44 30	
702	19.00	.083	11 45 30	
680	20.00	.056	11 47 00	
686	21.00	.083	11 48 00	
750	21.40	.....	.....	

SECOND SERIES OF TESTS—Continued.

SECOND BULLET.

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	0.	1 6 00	
50	.06	.....	.....	
100	.11	.009	1 7 00	
150	.16	.....	.....	
200	.20	.....	.....	
250	.23	.....	.....	
300	.29	.....	.....	
350	.32	.....	.....	
400	.37	.011	1 9 00	
500	.42	.....	.....	
600	.50	.....	.....	
700	.56	.....	.....	
800	.61	.010	1 11 00	
900	.78	.....	.....	
860	.90	.....	.....	
800	1.00	.....	.....	
760	1.10	.....	.....	
700	1.30	.019	1 14 00	
790	1.50	.....	.....	
930	2.00	.029	1 16 00	
1,032	2.50	.....	.....	
1,064	3.00	.033	1 18 30	
1,237	3.50	.....	.....	
				Changed pistons.
1,242	4.00	.....	1 30 30	
1,278	4.50	.042	1 33 30	
1,235	5.00	.....	.....	
1,224	5.50	.....	.....	
1,230	6.00	.033	1 35 00	
1,360	6.50	.....	.....	
1,380	7.00	.167	1 35 30	
1,406	7.50	.....	.....	
				Changed pistons.
1,425	8.00	.....	1 54 00	
1,360	9.00	.033	1 55 00	
1,410	10.00	.....	.....	
1,460	11.00	.033	1 57 00	
1,505	12.00	.....	.....	
1,483	12.50	.....	.....	
				Changed pistons.
1,600	12.60	.....	.....	Maximum resistance.
1,580	13.00	.....	2 9 00	
1,560	14.00	.042	2 11 00	
1,360	15.00	.167	2 11 30	
1,390	16.00	.....	.....	
1,282	17.00	.111	2 13 00	
1,195	18.00	.....	.....	
1,184	19.00	.....	.....	
1,200	20.00	.125	2 15 00	
1,248	21.00	.167	2 15 30	
500	21.70	.....	.....	

SECOND SERIES OF TESTS—Continued.

THIRD BULLET.

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	0.	2 27 00	
50	.07	.....	.....	
100	.18	.....	.....	
150	.20	.....	.....	
200	.28	.....	.....	
250	.29	.....	.....	
300	.32	.....	.....	
350	.37	.....	.....	
400	.40	.011	2 30 00	
500	.47	.....	.....	
600	.52	.....	.....	
700	.60	.....	.....	
800	.74	.019	2 31 30	
720	1.00	.....	.....	
710	1.30	.023	2 33 30	
684	1.50	.....	.....	
797	2.00	.023	2 36 00	
792	2.50	.....	.....	
808	3.00	.....	.....	
875	3.50	.083	2 37 30	
				Changed pistons.
918	4.00	.....	3 25 30	
1,088	5.00	.....	.....	
1,080	6.00	.....	.....	
1,083	7.00	.....	.....	
1,130	7.50	.117	3 28 00	
				Changed pistons.
1,118	8.00	.....	3 37 30	
1,155	9.00	.083	3 38 30	
1,250	10.00	.111	3 39 15	
1,340	11.00	.....	.....	
1,405	12.00	.095	3 41 00	
1,364	12.50	.....	.....	
				Changed pistons.
1,470	13.00	.....	3 48 00	
1,484	14.00	.....	.....	Maximum resistance.
1,310	15.00	.083	3 50 00	
1,266	16.00	.....	.....	
1,234	17.00	.....	.....	
1,144	18.00	.111	3 52 15	
1,150	19.00	.....	.....	
1,162	20.00	.095	3 54 00	
1,246	21.00	.....	.....	
500	21.60	.....	.....	

Tests discontinued and barrel returned to Springfield Armory for firing.

SECOND SERIES OF TESTS—Continued.

Same barrel returned from Springfield Armory after having been fired 3,500 rounds.

Regular bullets used, ½″ bearing length, ″.3072 diameter.

FOURTH BULLET.

[First after firing.]

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
0	0.	0.	10 37 30	
50	.24	.....	.....	
100	.43	.....	.....	
150	.62	.....	.....	
200	.91	.025	10 40 30	
250	1.28	.....	.....	
300	1.60	.....	.....	
350	1.85	.039	10 42 30	
383	2.50	.036	10 44 00	
				Changed pistons.
476	3.00	.....	10 52 00	
604	3.50	.033	10 53 15	
734	4.00	.....	.....	
882	4.50	.048	10 55 00	
945	5.00	.....	.....	
906	5.50	.042	10 57 00	
896	6.00	.....	.....	
888	6.50	.083	10 58 00	
				Changed pistons.
840	7.00	.....	11 7 00	
980	8.00	.....	.....	
968	9.00	.067	11 9 30	
921	10.00	.....	.....	
958	11.00	.111	11 11 00	
958	11.50	.....	.....	
				Changed pistons.
886	12.00	.....	11 16 30	
936	13.00	.....	.....	
966	14.00	.....	.....	
1,034	15.00	.125	11 18 30	
1,027	16.00	.....	.....	
1,061	17.00	.....	.....	
1,070	18.00	.125	11 20 30	Maximum resistance.
1,028	19.00	.....	.....	
1,010	20.00	.....	.....	
800	20.66	.....	.....	
500	20.82	.....	.....	
320	21.00	.....	.....	
100	21.20	.....	.....	

FIFTH BULLET.

[Second after firing.]

0	0.	.....	11 39 00	Bullet starts with its base 2″.95 from end of barrel.
50	.10	.....	.....	
100	.26	.....	.....	
150	.40	.017	11 41 00	
200	.53	.....	.....	
250	.68	.....	.....	
300	.88	.....	.....	
350	1.16	.....	.....	
400	1.70	.....	.....	
452	2.50	.070	11 43 30	
				Changed pistons.
558	3.00	.....	11 47 00	
635	3.50	.....	.....	
773	4.00	.056	11 48 30	
866	4.50	.....	.....	
915	5.00	.056	11 50 00	
960	5.50	.....	.....	
975	6.00	.....	.....	
996	6.50	.....	.....	
				Changed pistons.

SECOND SERIES OF TESTS—Continued.

FIFTH BULLET—Continued.

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	*Inches.*	*Foot.*	*h. m. s.*	
945	7.00	.....	11 54 30	
1,090	8.00	.....	.....	
1,095	9.00	.111	11 56 00	
1,067	10.00	.....	.....	
1,085	11.00	.111	11 57 30	
1,094	11.50	.....	.....	
				Changed pistons.
904	12.00	.....	12 03 00	
1,034	13.00	.....	.....	
1,066	14.00	.083	12 05 00	
1,140	15.00	.....	.....	
1,148	16.00	.....	.....	
1,126	17.00	.083	12 08 00	
1,160	18.00	.....	.....	Maximum resistance.
1,137	19.00	.....	.....	
1,110	20.00	.....	.....	
500	20.79	.....	.....	
160	21.00	.....	.....	

SIXTH BULLET.

[Third after firing.]

0.	0.	.....	1 21 00	Bullet starts with its base 3″ from end of barrel.
50	.17	.....	.....	
100	.30	.....	.....	
150	.47	.....	.....	
200	.65	.064	1 22 00	
250	.93	.....	.....	
300	1.68	.....	.....	
382	2.50	.077	1 24 00	
				Changed pistons.
384	3.00	.....	1 28 30	
462	3.50	.....	.....	
550	4.00	.....	.....	
595	4.50	.063	1 30 30	
654	5.00	.....	.....	
698	5.50	.....	.....	
705	6.00	.....	.....	
726	6.50	.067	1 33 00	
				Changed pistons.
780	7.00	.....	1 37 00	
852	8.00	.....	.....	
898	9.00	.....	.....	
860	10.00	.100	1 39 30	
834	11.00	.....	.....	
812	11.50	.083	1 41 00	
				Changed pistons.
755	12.00	.....	1 45 00	
841	13.00	.....	.....	
902	14.00	.111	1 46 30	Maximum resistance.
848	15.00	.....	.....	
820	16.00	.111	1 48 00	
800	17.00	.....	.....	
848	18.00	.083	1 50 00	
852	19.00	.....	.....	
818	20.00	.067	1 52 30	
500	20.65	.....	.....	

ROLLER BEARINGS.

Tests of Roller Bearings Furnished by the Standard Roller Bearing Company, Philadelphia, Pa.

Tests were made with three kinds of bearings, designated as "soft," "polished," and "ground."

Each bearing was run in the hub of a lead wheel, weighing 3,015 pounds, at a speed of 21 rotations per minute. The bearings were provided with inside and outside sleeves, between which the rollers were located. Outside diameter of lead wheel, 40 inches.

"SOFT" ROLLER BEARING.

Number of rollers		15
Diameter of rollers	inch..	.43
Length of rollers	inches..	3.90
Length of sleeves	do....	4.50
Exterior diameter of inside sleeve	do....	2.94
Interior diameter of outside sleeve	do....	3.82

This bearing was run 12,096 rotations, at which time the driving belt on the lead wheel ran off on account of the frictional resistance of the bearing. It now required a force of 25½ pounds, applied at the circumference of the lead wheel, to rotate it. The test was discontinued.

An examination of the bearing showed the rollers in a roughened, pitted condition. The surfaces of each sleeve next the rollers were also roughened and pitted. The injury to the surfaces of the rollers and sleeves was greatest along two-thirds of their length. The cause for the increased resistance of the bearing which occasioned the driving belt running off appeared to be the clogging of the rollers with metal from the sleeves and the rollers themselves.

"POLISHED" ROLLER BEARING.

Description same as "Soft" roller bearing.

This bearing was run 2,520 rotations, at the end of which time the driving belt of the lead wheel ran off on account of the frictional resistance of the bearing. It now required 20 pounds pull on the circumference of the lead wheel to rotate it. The test was discontinued.

An examination of the bearing showed the rollers were clogged with abraded metal in a finely ground state. After cleaning, the surfaces of the rollers and sleeves were found in good condition.

"GROUND" ROLLER BEARING.

Description same as "Soft" roller bearing.

This bearing was run 53,088 rotations, at the end of which time the driving belt of the lead wheel ran off on account of the frictional resistance of the bearing. It now required a pull of 26½ pounds at the circumference of the lead wheel to rotate it. The test was discontinued.

An examination of the bearing showed the rollers were clogged with abraded metal in a finely ground state. After cleaning, the surfaces of the rollers and sleeves were found in good condition.

It was not apparent from whence came the abraded metal which caused the frictional resistance to overcome the power of the driving belt in the tests of the "Polished" and "Ground" bearings. The final condition of the rollers and sleeves did not indicate that the abraded metal came from them in a marked degree. There was a considerable end thrust displayed by the bearings, and collars were used to keep the bearings in position. Oil was used as a lubricant between the ends of the bearings and the boxes which carried the journal. Some of the abraded metal was thought to have been detached from these boxes and some also from the ends of the cast-iron hub of the lead wheel.

COPPER CYLINDERS FOR PRESSURE GAUGES.

Mean compression of 10 cylinders from Frankford Arsenal. Metal purchased May 1, 1901. Metal annealed April 15, 1905.

Table for use with crusher gauge one-thirtieth square inch area.

Mean dimensions of cylinders: Length, 0″.4997, diameter, 0″.2056.

Load per square inch on crusher gauge one-thirtieth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
3,000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6,000	.0004	.0002	.0003	.0004	.0006	.0002	.0005	.0002	.0004	.0	.0003	.0001
9,000	.0015	.0009	.0012	.0013	.0021	.0015	.0012	.0007	.0009	.0005	.0012	.0007
10,000	.0026	.0017	.0021	.0020	.0036	.0030	.0025	.0013	.0010	.0018	.0022	.0016
11,000	.0040	.0022	.0036	.0046	.0050	.0041	.0038	.0028	.0019	.0030	.0035	.0029
12,000	.0052	.0035	.0054	.0051	.0069	.0054	.0060	.0040	.0041	.0048	.0050	.0043
13,000	.0071	.0042	.0066	.0060	.0084	.0078	.0066	.0058	.0057	.0066	.0065	.0057
14,000	.0094	.0061	.0083	.0094	.0097	.0093	.0087	.0068	.0068	.0080	.0083	.0074
15,000	.0105	.0070	.0099	.0116	.0118	.0105	.0106	.0090	.0088	.0097	.0099	.0089
16,000	.0128	.0079	.0115	.0124	.0131	.0124	.0130	.0110	.0100	.0114	.0116	.0105
17,000	.0138	.0094	.0136	.0134	.0154	.0144	.0135	.0125	.0123	.0134	.0132	.0121
18,000	.0160	.0111	.0154	.0156	.0167	.0160	.0156	.0146	.0139	.0155	.0150	.0139
19,000	.0175	.0129	.0171	.0171	.0188	.0185	.0174	.0160	.0161	.0169	.0168	.0157
20,000	.0196	.0147	.0192	.0194	.0210	.0216	.0197	.0175	.0172	.0191	.0189	.0178
21,000	.0215	.0172	.0218	.0212	.0226	.0224	.0210	.0186	.0196	.0210	.0207	.0196
22,000	.0236	.0184	.0229	.0231	.0244	.0238	.0235	.0204	.0219	.0229	.0225	.0214
23,000	.0257	.0205	.0260	.0270	.0264	.0262	.0259	.0250	.0234	.0248	.0251	.0240
24,000	.0275	.0230	.0274	.0287	.0281	.0288	.0273	.0279	.0249	.0269	.0271	.0259
25,000	.0298	.0239	.0300	.0290	.0308	.0305	.0296	.0298	.0269	.0300	.0290	.0278
26,000	.0325	.0266	.0316	.0315	.0330	.0338	.0318	.0320	.0289	.0309	.0313	.0301
27,000	.0337	.0293	.0342	.0330	.0349	.0365	.0336	.0341	.0301	.0335	.0333	.0321
28,000	.0358	.0310	.0362	.0356	.0377	.0371	.0366	.0363	.0343	.0354	.0356	.0344
29,000	.0387	.0336	.0382	.0383	.0392	.0389	.0386	.0388	.0364	.0376	.0378	.0366
30,000	.0412	.0370	.0422	.0404	.0415	.0417	.0405	.0406	.0380	.0407	.0404	.0392
31,000	.0429	.0386	.0432	.0421	.0442	.0450	.0433	.0437	.0390	.0420	.0424	.0412
32,000	.0459	.0406	.0451	.0450	.0464	.0463	.0455	.0456	.0409	.0449	.0446	.0434
33,000	.0478	.0436	.0481	.0470	.0485	.0488	.0474	.0472	.0429	.0466	.0468	.0456
34,000	.0501	.0448	.0500	.0494	.0513	.0519	.0500	.0500	.0450	.0498	.0492	.0480
35,000	.0535	.0480	.0529	.0518	.0538	.0534	.0540	.0521	.0470	.0515	.0518	.0504
36,000	.0546	.0510	.0560	.0543	.0565	.0570	.0549	.0545	.0494	.0544	.0543	.0529
37,000	.0574	.0532	.0580	.0564	.0588	.0601	.0579	.0571	.0527	.0566	.0568	.0554
38,000	.0610	.0549	.0605	.0595	.0609	.0614	.0600	.0600	.0545	.0591	.0592	.0578
39,000	.0627	.0580	.0636	.0609	.0625	.0634	.0623	.0618	.0560	.0617	.0613	.0599
40,000	.0655	.0608	.0653	.0647	.0644	.0664	.0653	.0640	.0588	.0647	.0640	.0626
41,000	.0681	.0634	.0680	.0668	.0668	.0694	.0666	.0670	.0616	.0680	.0666	.0652
42,000	.0710	.0658	.0706	.0685	.0710	.0713	.0690	.0692	.0643	.0693	.0690	.0676
43,000	.0732	.0687	.0730	.0719	.0725	.0745	.0728	.0718	.0661	.0719	.0716	.0702
44,000	.0751	.0716	.0760	.0741	.0751	.0768	.0754	.0740	.0686	.0748	.0741	.0727
45,000	.0793	.0745	.0784	.0766	.0771	.0794	.0774	.0752	.0711	.0778	.0766	.0752
46,000	.0811	.0767	.0819	.0802	.0800	.0821	.0803	.0772	.0736	.0794	.0793	.0779
47,000	.0845	.0810	.0835	.0820	.0832	.0851	.0838	.0805	.0769	.0821	.0823	.0809
48,000	.0862	.0828	.0865	.0850	.0852	.0878	.0861	.0822	.0784	.0847	.0845	.0831
49,000	.0898	.0852	.0890	.0870	.0881	.0903	.0880	.0849	.0812	.0886	.0872	.0858
50,000	.0919	.0880	.0920	.0904	.0905	.0929	.0912	.0876	.0838	.0910	.0899	.0885
51,000	.0952	.0915	.0949	.0928	.0944	.0967	.0937	.0906	.0873	.0936	.0931	.0917
52,000	.0979	.0961	.0975	.0964	.0973	.0988	.0965	.0938	.0905	.0964	.0960	.0946
53,000	.1008	.0996	.0997	.0980	.1003	.1016	.0995	.0962	.0925	.0996	.0988	.0974
54,000	.1034	.1031	.1020	.1030	.1038	.1033	.1024	.0998	.0960	.1015	.1018	.1004
55,000	.1068	.1069	.1051	.1066	.1062	.1068	.1063	.1022	.0995	.1051	.1052	.1038
56,000	.1095	.1091	.1085	.1107	.1093	.1090	.1094	.1043	.1025	.1078	.1080	.1067
57,000	.1152	.1132	.1112	.1120	.1135	.1116	.1118	.1076	.1062	.1100	.1112	.1099
58,000	.1180	.1170	.1149	.1148	.1161	.1149	.1140	.1103	.1105	.1128	.1143	.1130
59,000	.1216	.1220	.1175	.1181	.1200	.1180	.1175	.1136	.1155	.1175	.1181	.1168
60,000	.1251	.1272	.1211	.1197	.1220	.1196	.1205	.1160	.1192	.1195	.1210	.1197
62,000	.1350	.1415	.1285	.1263	.1318	.1260	.1265	.1215	.1290	.1252	.....	.....
64,000	.1450	.1545	.1322	.1310	.1407	.1302	.1318	.1263	.1410	.1305	.....	.....
66,000	.1570	.1718	.1391	.1379	.1508	.1366	.1380	.1314	.1522	.1352	.....	.....
68,000	.1660	.1952	.1438	.1460	.1613	.1430	.1450	.1364	.1660	.1410	.....	.....
70,000	.1790	.2165	.1497	.1550	.1760	.1480	.1520	.1415	.1810	.1461	.....	.....
72,000	.1910	.2357	.1550	.1628	.1867	.1535	.1640	.1470	.2008	.1510	.....	.....
74,000	.2068	.2465	.1598	.1725	.1990	.1589	.1742	.1512	.2170	.1560	.....	.....
76,000	.2189	.....	.1680	.1825	.2120	.1653	.1829	.1570	.2280	.1605	.....	.....
78,000	.2305	.....	.1729	.1920	.2235	.1678	.1930	.1605	.2405	.1675	.....	.....
80,000	.2395	.....	.1810	.2015	.2336	.1725	.2004	.1655	.2464	.1736	.....	.....
82,000	.2465	.....	.1872	.2100	.2420	.1778	.2120	.1720	.....	.1802	.....	.....

Load per square inch on crusher gauge one-thirtieth square inch area	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
84,000	.....	.....	.1930	.2175	.2470	.1828	.2209	.1755	.....	.1874	.....	.....
86,000	.....	.....	.2009	.2260	.....	.1864	.2295	.1810	.....	.1935	.....	.....
88,000	.....	.....	.2059	.2335	.....	.1912	.2370	.1865	.....	.1991	.....	.....
90,000	.....	.....	.2124	.2400	.....	.1964	.2430	.1915	.....	.2052	.....	.....
92,000	.....	.....	.2178	.2458	.....	.2030	.....	.1948	.....	.2121	.....	.....
94,000	.....	.....	.2240	.2502	.....	.2050	.....	.1993	.....	.2190	.....	.....
96,000	.....	.....	.2282	.....	.....	.2100	.....	.2054	.....	.2250	.....	.....
98,000	.....	.....	.2342	.....	.....	.2145	.....	.2090	.....	.2290	.....	.....
100,000	.....	.....	.2382	.....	.....	.2191	.....	.2130	.....	.2347	.....	.....

Mean compression of 10 cylinders from Frankford Arsenal. Metal purchased May 1, 1901. Metal annealed April 15, 1905.

Table for use with crusher gauge one-tenth square inch area.

Mean dimensions of cylinders: Length, ".4996; diameter, ".2521.

Load per square inch on crusher gauge one-tenth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
3,000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6,000	.0029	.0046	.0035	.0044	.0005	.0058	.0037	.0047	.0024	.0017	.0034	.0032
9,000	.0115	.0169	.0145	.0147	.0110	.0165	.0150	.0150	.0114	.0098	.0136	.0131
10,000	.0152	.0200	.0159	.0160	.0152	.0193	.0179	.0195	.0156	.0138	.0168	.0162
11,000	.0193	.0223	.0197	.0211	.0196	.0236	.0227	.0229	.0190	.0175	.0208	.0202
12,000	.0234	.0264	.0235	.0249	.0235	.0276	.0266	.0273	.0231	.0213	.0248	.0241
13,000	.0272	.0305	.0279	.0285	.0274	.0318	.0300	.0310	.0278	.0250	.0287	.0279
14,000	.0318	.0354	.0316	.0331	.0315	.0363	.0340	.0355	.0316	.0300	.0331	.0322
15,000	.0357	.0400	.0367	.0370	.0358	.0408	.0385	.0397	.0370	.0340	.0375	.0365
16,000	.0413	.0440	.0400	.0419	.0404	.0452	.0425	.0440	.0414	.0388	.0420	.0409
17,000	.0458	.0490	.0423	.0456	.0464	.0495	.0480	.0490	.0467	.0435	.0466	.0455
18,000	.0498	.0527	.0470	.0491	.0492	.0550	.0515	.0536	.0505	.0484	.0507	.0496
19,000	.0558	.0580	.0514	.0536	.0552	.0587	.0562	.0575	.0569	.0530	.0566	.0545
20,000	.0610	.0631	.0570	.0573	.0595	.0637	.0610	.0625	.0603	.0581	.0604	.0593
21,000	.0664	.0689	.0611	.0620	.0639	.0688	.0657	.0670	.0654	.0631	.0652	.0641
22,000	.0707	.0724	.0655	.0666	.0691	.0729	.0707	.0719	.0713	.0688	.0700	.0689
23,000	.0765	.0780	.0713	.0709	.0740	.0784	.0748	.0770	.0755	.0732	.0750	.0739
24,000	.0820	.0824	.0756	.0759	.0789	.0830	.0800	.0817	.0810	.0788	.0799	.0787
25,000	.0871	.0876	.0814	.0824	.0839	.0880	.0855	.0868	.0868	.0850	.0855	.0843
26,000	.0925	.0930	.0858	.0858	.0898	.0932	.0895	.0937	.0918	.0890	.0904	.0892
27,000	.0990	.0976	.0912	.0923	.0935	.0989	.0960	.0961	.0972	.0950	.0957	.0945
28,000	.1026	.1028	.0966	.0964	.0993	.1040	.1003	.1024	.1019	.1000	.1006	.0994
29,000	.1095	.1081	.1014	.1019	.1041	.1087	.1055	.1070	.1070	.1057	.1059	.1047
30,000	.1129	.1128	.1068	.1069	.1097	.1145	.1104	.1118	.1121	.1114	.1109	.1097
31,000	.1171	.1180	.1114	.1120	.1148	.1189	.1163	.1170	.1166	.1163	.1158	.1146
32,000	.1229	.1233	.1165	.1184	.1195	.1252	.1207	.1220	.1222	.1220	.1213	.1201
33,000	.1277	.1287	.1219	.1220	.1254	.1293	.1259	.1280	.1275	.1272	.1264	.1252
34,000	.1338	.1338	.1270	.1272	.1297	.1350	.1305	.1320	.1328	.1314	.1313	.1301
35,000	.1400	.1388	.1323	.1323	.1360	.1409	.1368	.1379	.1380	.1365	.1370	.1356
36,000	.1445	.1438	.1365	.1380	.1405	.1454	.1410	.1426	.1432	.1418	.1417	.1403
37,000	.1509	.1493	.1428	.1439	.1465	.1497	.1463	.1479	.1489	.1470	.1473	.1459
38,000	.1554	.1538	.1469	.1486	.1513	.1560	.1513	.1498	.1536	.1523	.1519	.1505
39,000	.1618	.1587	.1515	.1535	.1570	.1612	.1560	.1585	.1584	.1569	.1574	.1560
40,000	.1669	.1641	.1570	.1590	.1618	.1657	.1607	.1620	.1638	.1620	.1623	.1609
41,000	.1730	.1681	.1620	.1660	.1665	.1719	.1659	.1644	.1690	.1675	.1674	.1660
42,000	.1783	.1734	.1675	.1715	.1719	.1759	.1700	.1700	.1735	.1723	.1724	.1710
43,000	.1829	.1785	.1711	.1770	.1766	.1815	.1758	.1750	.1785	.1771	.1774	.1760
44,000	.1885	.1835	.1770	.1830	.1815	.1854	.1808	.1800	.1837	.1826	.1826	.1812

Load per square inch on crusher gauge one-tenth square inch area.	Total compressions.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	Mean corrected sets.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
45,000	.1930	.1885	.1818	.1874	.1864	.1905	.1855	.1850	.1883	.1873	.1874	.1860
46,000	.1985	.1925	.1868	.1930	.1909	.1957	.1906	.1890	.1930	.1921	.1922	.1908
47,000	.2040	.1956	.1905	.1981	.1962	.2008	.1948	.1940	.1985	.1970	.1969	.1955
48,000	.2083	.2000	.1958	.2025	.2001	.2043	.1998	.1988	.2004	.2025	.2012	.1998
49,000	.2136	.2023	.1995	.2070	.2038	.2070	.2050	.2030	.2049	.2065	.2058	.2039
50,000	.2171	.2066	.2048	.2107	.2087	.2143	.2097	.2079	.2091	.2114	.2100	.2086
51,000	.2214	.2114	.2094	.2154	.2120	.2180	.2130	.2123	.2143	.2156	.2143	.2129
52,000	.2251	.2158	.2131	.2198	.2167	.2210	.2155	.2161	.2179	.2198	.2181	.2167
53,000	.2290	.2198	.2175	.2240	.2209	.2235	.2190	.2208	.2220	.2230	.2219	.2205
54,000	.2325	.2234	.2215	.2278	.2249	.2285	.2230	.2244	.2260	.2277	.2260	.2246
55,000	.2367	.2269	.2256	.2330	.2280	.2319	.2270	.2285	.2300	.2307	.2298	.2284
56,000	.2400	.2310	.2288	.2360	.2320	.2358	.2308	.2320	.2339	.2354	.2336	.2323
57,000	.2433	.2348	.2330	.2390	.2362	.2394	.2349	.2360	.2372	.2385	.2372	.2359
58,000	.2470	.2380	.2365	.2424	.2400	.2426	.2360	.2400	.2406	.2414	.2405	.2392
59,000	.2500	.2419	.2400	.2451	.2428	.2460	.2415	.2482	.2441	.2431	.2438	.2425
60,000	.2534	.2456	.2431	.2494	.2460	.2494	.2444	.2463	.2471	.2465	.2471	.2458
62,000	.2596	.2518	.2494	.2563	.2525	.2565	.2520	.2529	.2539	.2540	.2539	.2526
64,000	.2648	.2569	.2554	.2600	.2565	.2610	.2570	.2584	.2594	.2581	.2588	.2575
66,000	.2706	.2630	.2605	.2654	.2637	.2660	.2630	.2644	.2655	.2650	.2647	.2634
68,000	.2745	.2678	.2660	.2710	.2684	.2735	.2682	.2695	.2702	.2690	.2698	.2686
70,000	.2795	.2732	.2710	.2766	.2734	.2770	.2739	.2750	.2761	.2740	.2750	.2738
72,000	.2845	.2781	.2771	.2811	.2780	.2820	.2785	.2791	.2806	.2790	.2798	.2786
74,000	.2883	.2829	.2802	.2860	.2830	.2870	.2832	.2838	.2851	.2837	.2843	.2831
76,000	.2925	.2870	.2846	.2902	.2874	.2915	.2889	.2888	.2895	.2881	.2889	.2877
78,000	.2966	.2915	.2888	.2950	.2908	.2963	.2920	.2932	.2938	.2923	.2930	.2918
80,000	.3007	.2951	.2931	.2979	.2951	.3004	.2962	.2969	.2978	.2965	.2970	.2958
82,000	.3039	.2989	.2970	.3020	.2988	.3035	.3000	.3015	.3015	.3005	.3008	.2996
84,000	.3074	.3028	.3013	.3064	.3026	.3069	.3040	.3045	.3059	.3044	.3046	.3036
86,000	.3109	.3066	.3049	.3098	.3049	.3112	.3079	.3081	.3090	.3080	.3081	.3071
88,000	.3140	.3103	.3081	.3134	.3098	.3144	.3115	.3119	.3128	.3115	.3118	.3108
90,000	.3171	.3135	.3115	.3165	.3128	.3178	.3150	.3149	.3160	.3150	.3150	.3140
92,000	.3201	.3164	.3145	.3190	.3158	.3212	.3182	.3183	.3190	.3176	.3180	.3171
94,000	.3235	.3194	.3179	.3228	.3189	.3239	.3214	.3215	.3224	.3204	.3212	.3203
96,000	.3264	.3222	.3202	.3255	.3224	.3270	.3240	.3247	.3246	.3240	.3241	.3232
98,000	.3284	.3250	.3232	.3273	.3245	.3295	.3270	.3271	.3275	.3269	.3266	.3259
100,000	.3316	.3277	.3260	.3309	.3279	.3325	.3298	.3300	.3310	.3299	.3297	.3288

Proof Stresses.

PISTON RODS.

For—	Diameter of body.	Proof stress applied.
	Inches.	*Pounds.*
10-inch disappearing carriages	3¼	240,000

RETRACTION ROPES.

For—	Diameter of rope.	Proof stress applied.
	Inch.	*Pounds.*
6-inch disappearing carriages, models 1898, 1903	¾	9,000
12-inch disappearing carriages	⅞	15,000

COUNTERWEIGHT CHAINS.

For—	Diameter of wire.	Proof stress applied.
	Inch.	*Pounds.*
15-pounder mounts	¼	3,640

Sheet Brass for Cartridge Clip Bodies.

Mark on specimen.	Dimensions in inches.		Sectional area.	Elastic limit (approximate).		Tensile strength.		Elongation in 8 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	Width.	Thickness.		Total.	Per square inch.	Total.	Per square inch.	Inches.	Per cent.				
			Sq. in.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*			*In. In. Sq. in.*	*Per ct.*		
1.....	1.523	.021	.032	2,250	70,310	2,440	76,250	.37	4.6	1.39×.017=.024	25.0	Light yellow, oblique .	.01, .01, .12*, .19*, .02, .01, .01, .00
1.....	1.524	.021	.032	2,260	70,630	2,380	74,380	.37	4.6	1.37×.018=.025	21.9	.....do.....	.00, .01, .00, .01, .01, .02, .25* .07
1.....	1.525	.021	.032	2,260	70,630	2,380	74,380	.45	5.6	1.38×.018=.025	21.9	.....do.....	.02, .01, .02, .04, .15*, .18*, .08, .00
2.....	1.527	.021	.032	2,250	70,310	2,400	75,000	.40	5.0	1.39×.018=.025	21.9	.....do.....	.01, .02, .01, .01, .02, .13*, .18*, .02
2.....	1.528	.021	.032	2,200	68,750	2,360	73,750	.39	5.0	1.37×.018=.025	21.9	.....do.....	.00, .00, .01, .01, .01, .22*, .13*, .01
2.....	1.525	.021	.032	2,150	67,190	2,390	74,690	.37	4.6	1.38×.017=.023	28.1	.....do.....	.00, .01, .02, .01, .01, .15*, .16*, .01
3.....	1.527	.020	.031	500	16,130	1,220	39,350	2.26	28.2	1.32×.016=.021	32.3	.....do.....	.26, .28, .28, .28, .28, .28, .35*, .25
3.....	1.529	.020	.031	480	15,480	1,290	41,610	2.84	35.5	1.30×.016=.021	32.3	.....do.....	.34, .35, .34, .35, .36, .42*, .35, .33
3.....	1.528	.020	.031	500	16,130	1,340	43,230	3.63	45.4	1.22×.015=.018	41.9	.....do.....	.41, .46, .44, .46, .56*, .45, .44, .41

WHEELS FOR FIELD CARRIAGES AND LIMBERS.

3-INCH FIELD CARRIAGE WHEEL.

16 SPOKES.

HELIOTYPE CO., BOSTON.

Wheels for Field Carriages and Limbers.

Twenty-four wheels are represented in this series of tests. Of this number there were two wheels for a 3″.2 carriage and limber, twenty for 3″ field carriages, model 1902, and two for Ehrhardt field carriages. One of the Ehrhardt wheels was made with wooden spokes and rim, the other of iron or steel throughout, all others of the series being wooden wheels of the Archibald type, with metal hubs.

LIST OF WHEELS TESTED.

Number of wheel.	Description.	Received from—
1	16-spoke wheel, ¼″ tire, for 3″.2 field carrriage	Rock Island Arsenal.
2	16-spoke wheel, ¼″ tire, for 3″.2 field limber	Do.
3	14-spoke wheel, ¼″ tire, for 3″ field carriage	Archibald Wheel Co.
4	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
5	14-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
6	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
7	14-spoke wheel, ¼″ tire, for 3″ field carriage	Seventh Battery, Field Artillery.
8	.....do	Rock Island Arsenal.
9	16-spoke wheel, ¼″ tire, steel hub, for 3″ field carriage	Archibald Wheel Co.
10	16-spoke wheel, ¼″ tire, cast-iron hub, for 3″ field carriage	Do.
11	12-spoke Ehrhardt wooden wheel, ″.43 tire	Sandy Hook proving ground.
12	14-spoke Ehrhardt steel wheel, ″.43 tire	Do.
13	16-spoke wheel, ¼″ tire, for 3″ field carriage	Archibald Wheel Co.
14	.....do	Do.
15	.....do	Do.
16	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
17	.....do	Do.
18	.....do	Do
19	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
20	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
21	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
22	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
23	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.
24	16-spoke wheel, ¼″ tire, for 3″ field carriage	Do.

The wheels were new with the exception of No. 7 from the Seventh Battery, Field Artillery, which was selected for testing after having been subjected to severe service conditions and from which the original dishing had been partially removed.

The tests made pertained to—

1. Circularity of the rims of four wheels.
2. Force required to overcome the dishing.
3. Strains in the tires.
4. Tensile test of the tire metal and hubs.
5. Nave-box flanges.

1. The circularity of the rims was determined by means of calipering the diameters of the tires at points over the ends of the spokes and midway their ends.

2. The tests to overcome the dishing were made by supporting the inner end of the nave box against one end of the testing machine and loading the rim at four points equidistant. Six of the wheels, however, were tested by loads applied to the rim at one place, the reaction being taken by the hub. A short piece of axle was used, the journal portion of which entered the hub and the short, outer part, entered one end of an arm, making a bent axle with length of arm equal to the radius of the wheel. An initial load was applied to the wheel and

testing fixtures and observations made thereafter on the movement of the rim, noting the distance traveled when the dishing was removed. Loads were continued until the total rim movement with reference to the nave reached a distance of 1″ beyond the position it had while under the load initially applied to the system. The amount of permanent set was observed at different stages during the progress of and upon the discontinuance of the tests.

3. Observations were made on the strains in the tires by means of measurements on gauged lengths of 5″ each, established on the tires when the latter were intact, and the changes noted which occurred upon cutting the tire apart midway these lengths. The final measurements, as well as the initial ones, were made with the tires over the felloes, and, as the rims themselves expanded when relieved of the tire shrinkage, the observed changes were comparative only. Instability of form made it necessary to remeasure over the felloes and prevented the actual strains in the tires being determined.

In addition to the general extension of the metal, each of the new tires were in a state of unequal tension with reference to different parts of their cross section. Tires freed from the wheels sprung together, their ends overlapping, and assumed diameters smaller than that of the felloes. This behavior indicated that the metal at the inner surface of the tire was in a state of tension, the outer surface in a state of compression, with reference to the two sides of the same. The ordinary method of cooling tires when setting, by throwing water on them, would account for these initial strains in the new tires. The tire of the old wheel from the Seventh Battery, Field Artillery, did not spring together when removed from the felloe; service condition had eliminated the difference in strains at the inside and outside of the tire, respectively. The difference in the gauged length before and after cutting apart, furthermore, is seen to be less than in the cases of the other wheels.

4. Tensile tests of the tire metal comprised tests made at the welds and at places remote therefrom.

5. The nave boxes were tested by supporting the flanges at their rims upon a ring of metal having an annular bearing, the width of which was $\frac{5}{8}$″. The loads were noted which caused a dishing effect, which for comparison were observed when an opening of 0″.02 was reached at the outer edge of the flange, between that and the testing ring against which it rested. This distance was adopted for reference and comparative purposes, and corresponded to a time after which there was a more rapid change in the rate of deformation.

TESTS ON CIRCULARITY OF THE RIMS.

Diameters of the wheels, measured over the tires, taken at places opposite the ends of the spokes and midway thereof. The odd numbers represent the measurements on the line of the spokes, the even numbers midway between them.

WHEEL No. 1.

16-spoke wheel for 3.2-inch field carriage, received from Rock Island Arsenal.

Tire, ½" thick by 2".82 wide; felloe, in eight segments, 3".07 deep by 2".59 wide; weight, 204 pounds.

DIAMETERS.

Number.	Length.	Excess over minimum.	Number.	Length.	Excess over minimum.	Number.	Length.	Excess over minimum.
	Inches.	*Inch.*		*Inches.*	*Inch.*		*Inches.*	*Inch.*
1	57.79	.19	7	57.81	.21	12	57.73	.13
2	57.77	.17	8	57.74	.14	13	57.82	.22
3	57.69	.09	9	57.82	.22	14	57.83	.23
4	57.60	0.	10	57.85	.25	15	57.73	.13
5	57.74	.14	11	57.79	.19	16	57.65	.05
6	57.81	.21						

Diameter No. 16 was over junction of felloe segments.

WHEEL No. 3.

14-spoke wheel for 3-inch field carriage, model 1902, received from Archibald Wheel Company, Lawrence, Mass.

Tire, ⅝" thick by 2".96 wide; felloe, in two segments, 2".20 deep by 2".78 wide.

DIAMETERS.

Number.	Length.	Excess over minimum.	Number.	Length.	Excess over minimum.	Number.	Length.	Excess over minimum.
	Inches.	*Inch.*		*Inches.*	*Inch.*		*Inches.*	*Inch.*
1	55.79	.16	6	55.75	.12	11	55.75	.12
2	55.76	.13	7	55.78	.15	12	55.63	0.
3	55.78	.15	8	55.75	.12	13	55.68	.05
4	55.74	.11	9	55.79	.16	14	55.67	.04
5	55.79	.16	10	55.77	.14			

Diameter No. 14 was over junction of felloe segments.

WHEEL NO. 7.

14-spoke wheel for 3-inch field carriage, received from Seventh Battery, Field Artillery, Fort Riley. This wheel had been in service.

Tire, $\frac{3}{8}$" thick by 2".96 wide; felloe, in two segments, 2".14 deep by 2".68 wide.

The rim of this wheel was polygonal, being flattened between spokes.

DIAMETERS.

Number.	Length.	Excess over minimum.	Number.	Length.	Excess over minimum.	Number.	Length.	Excess over minimum.
	Inches.	*Inch.*		*Inches.*	*Inch.*		*Inches.*	*Inch.*
1	55.95	.36	6	55.87	.28	11	55.98	.39
2	55.96	.37	7	55.99	.40	12	55.81	.22
3	56.02	.43	8	55.87	.28	13	55.79	.20
4	55.94	.35	9	55.98	.39	14	55.59	0.
5	55.99	.40	10	55.92	.33			

Diameter No. 14 was over junction of felloe segments.

WHEEL NO. 8.

14-spoke wheel for 3-inch field carriage, received from Rock Island Arsenal.

Tire, $\frac{3}{8}$" thick by 2".98 wide; felloe, in two segments, 2".14 deep by 2".76 wide; weight, 125 pounds.

DIAMETERS.

Number.	Length.	Excess over minimum.	Number.	Length.	Excess over minimum.	Number.	Length.	Excess over minimum.
	Inches.	*Inch.*		*Inches.*	*Inch.*		*Inches.*	*Inch.*
1	55.72	.02	6	55.93	.23	11	55.87	.17
2	55.70	0.	7	55.92	.22	12	55.86	.16
3	55.83	.13	8	55.84	.14	13	55.89	.19
4	55.87	.17	9	55.86	.16	14	55.80	.10
5	55.94	.24	10	55.84	.14			

Diameter No. 14 was over junction of felloe segments.

TESTS ON FORCE REQUIRED TO OVERCOME THE DISHING.

FIRST GROUP.

Tests on the resistance of the wheels against movement of the rims with reference to the naves, to show the force required to overcome dishing and to cause additional movement of the rims. Rims loaded on outside face of wheels in four places, equidistant; naves supported at their inner ends.

WHEEL No. 1.

16-spoke wheel for 3.2-inch field carriage, received from Rock Island Arsenal.

Tire, $\frac{1}{2}$" thick by 2".82 wide; felloe, in eight segments, 3".07 deep by 2".59 wide; weight, 204 pounds.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
4,000	.31	
6,000	.50	
8,000	.76	Dishing nearly gone.
8,500	.82	
9,000	.88	
9,500	.99	
10,000	1.08	Wheel creaked.
4,000	.57	
6,000	.70	
8,000	.87	
8,500	.90	
9,000	.95	
9,500	1.00	
10,000	1.05	
4,000	.57	
500	.19	
4,000	.49	
8,000	.87	
8,500	.90	
9,000	.96	
9,500	1.00	
10,000	1.07	
10,000	1.08	After 2 minutes.
4,000	.59	
500	.19	
500	.17	
4,000	.47	
8,000	.85	
9,000	.96	
10,000	1.07	
10,000	1.08	Do.
4,000	.60	
500	.20	

WHEEL NO. 2.

16-spoke wheel for 3.2-inch field limber, received from Rock Island Arsenal.

Tire, ½″ thick; weight, 176 pounds.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
2,000	.13	
4,000	.35	
6,000	.64	Wheel creaked.
6,450	.75	Dishing about gone.
500	.14	
500	.13	After 2 minutes.
2,000	.28	
4,000	.48	
6,000	.71	
6,200	.75	
500	.14	
2,000	.28	
4,000	.48	
6,000	.72	
6,180	.75	
500	.16	
6,160	.75	
500	.15	
6,220	.75	
7,000	.88	
7,640	1.00	
500	.18	
500	.16	After 1¼ hours' rest.
5,980	.75	
7,580	1.00	
500	.18	

WHEEL NO. 3.

14-spoke wheel for 3-inch field carriage, model 1902, received from Archibald Wheel Company, Lawrence, Mass.

Tire, ⅜″ thick by 2″.96 wide; felloe, in two segments, 2″.20 deep by 2″.78 wide.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.04	
1,500	.12	
2,000	.21	
2,500	.30	
3,000	.39	
3,500	.49	Wheel creaked. Dishing taken out.
4,000	.61	
4,510	.75	
500	.14	
4,200	.75	
5,000	.92	
5,200	1.00	
500	.22	
3,960	.75	
500	.22	

WHEEL NO. 4.

16-spoke wheel for 3-inch field carriage, model 1902, received from Archibald Wheel Company, Lawrence, Mass.
Tire, $\frac{3}{8}$" thick.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.07	
1,500	.12	
2,000	.19	
2,500	.27	
3,000	.35	Dishing removed.
3,500	.43	
4,000	.55	
4,300	.....	Wheel creaked.
4,500	.67	
4,880	.75	
500	.11	
4,800	.75	
5,000	.81	
5,500	.95	
5,620	1.00	
500	.19	
4,250	.75	
500	.19	

WHEEL NO. 5.

14-spoke wheel for 3-inch field carriage, received from Archibald Wheel Company, Lawrence, Mass.
Tire, $\frac{1}{2}$" thick.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.07	
1,500	.13	
2,000	.22	
2,500	.30	
3,000	.40	
3,500	.51	Wheel creaked. Dishing removed.
500	.07	
4,000	.63	
4,350	.75	
500	.12	
4,500	.80	
5,000	.95	
5,100	1.00	
500	.22	
3,860	.75	
500	.23	

WHEEL No. 6.

16-spoke wheel for 3-inch field carriage, received from Archibald Wheel Company, Lawrence, Mass.
Tire, ½″ thick.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.06	
1,500	.11	
2,000	.19	
2,500	.25	
3,000	.33	
3,500	.41	
4,000	.51	
4,100	.54	Wheel creaked.
4,800	.72	Dishing removed.
500	.18	
4,860	.75	
5,000	.79	
5,500	.98	
5,680	1.00	
500	.27	
4,250	.75	
500	.27	

SECOND GROUP.

Tests on the resistance of wheels against movement of the rims with reference to the naves, to show the force required to overcome dishing and to cause additional movement of the rims. Rims loaded on outside face of wheels in four places, equidistant; naves supported at their inner ends.

Also tests on the resistance of wheels against movement of the rims with reference to the naves, to show the force required to increase dishing. Rims loaded in the same manner as above, but on the inside, with naves supported at their outer ends.

WHEEL NO. 9.

GOVERNMENT WHEEL.

16-spoke wheel with steel hub, for 3-inch field carriage, received from Archibald Wheel Company, Lawrence, Mass.

Tire, ½" thick by 2".97 wide; felloe, in two segments, 2".10 deep by 2".72 wide; weight, 158 pounds. Amount of dishing, ".96.

The spokes of this wheel were bent. Measured on the concave side the deflections, measured on a chord of 18", were: ".06, ".05, ".09, ".10, ".13, ".11, ".13, ".07, ".08, ".13, ".12, ".10, ".10, ".11, ".06, ".10.

TEST ON FORCE REQUIRED TO OVERCOME THE DISHING.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.04	
1,500	.09	
2,000	.14	
2,500	.19	
3,000	.23	
3,200	.....	Wheel creaked.
3,500	.31	
4,000	.39	
4,500	.48	
5,000	.63	
5,500	.83	Dishing removed at about ".96 movement.
	1.09	After sustaining load 8 minutes.
500	.39	
5,500	1.09	
500	.39	
1,000	.42	
1,500	.48	
2,000	.58	
2,500	.60	
3,000	.66	
3,500	.72	
4,000	.80	
4,500	.88	
5,000	.99	
5,500	1.09	
500	.39	

Wheel removed from testing machine.

Deflections of spokes, measured on chord of 18", now: ".05, ".04, ".09, ".09, ".12, ".11, ".12, ".07, ".09, ".12, ".11, ".08, ".08, ".08, ".05, ".10.

Wheel returned to testing machine and loaded in the opposite direction to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.04	
1,300	.....	Wheel creaked.
1,500	.14	
2,000	.28	
2,500	.32	
3,000	.42	
3,500	.50	
4,000	.61	
4,500	.73	
5,000	.83	
5,500	.96	After sustaining load 8 minutes.
	1.02	
500	.60	
5,500	1.01	
500	.61	
1,000	.68	
1,500	.68	
2,000	.70	
2,500	.78	
3,000	.78	
3,500	.81	
4,000	.87	
4,500	.90	
5,000	.97	
5,500	1.02	
500	.61	

Wheel removed from testing machine.

The spokes showed a movement at the circumference of inner nave box flange of about ".03 each. This was evidenced by the fresh surface of wood exposed to view. At the outer ends of the spokes and on the opposite side—that is, on the outside face of the wheel—there were openings of ".01 to ".02 between the felloe and the ends of the spokes. The joints were all closed at this place on the other side of the wheel.

Deflections of spokes, measured on chord of 18", now: ".06, ".03, ".08, ".09, ".13, ".09, ".13, ".07, ".08, ".12, ".10, ".09, ".08, ".07, ".04, ".09.

WHEEL No. 10.

16-spoke wheel with regular, cast-iron, Archibald hub, for 3-inch field carriage, received from Archibald Wheel Company, Lawrence, Mass.

Tire, ½" thick. Weight: wheel, 174 pounds; nut on hub, 2.5 pounds; total, 176.5 pounds. Amount of dishing, ".58.

The spokes of this wheel were bent. Measured on the concave side, the deflections, on a chord of 18", were: ".02, ".09, ".08, ".08, ".02, ".10, ".08, ".08, ".03, ".12, ".06, ".05, ".07, ".07, ".07, ".07.

TEST ON FORCE REQUIRED TO OVERCOME THE DISHING.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.08	
1,500	.09	
2,000	.15	
2,500	.20	
3,000	.25	
3,500	.31	
4,000	.37	
4,500	.42	
5,000	.51	
5,500	.60	
5,800	.....	Wheel creaked.
6,000	.72	Dishing removed.
6,500	.88	
7,000	1.00 1.12	After sustaining load 8 minutes.
500	.35	
		Measurement of diameter of wheel, taken between ends of spokes:
		Micrometer readings—
500	.....	".0012
7,000	.....	".0010
500	.....	".0014
7,000	1.18	".0006
500	.48	".0016
		——— ".0011 difference.
		Same taken opposite ends of spokes:
		Micrometer readings—
500	.....	—".0236
7,000	.....	—".0244
500	.....	—".0236
		——— ".0008 difference.
		The wheel is seen to decrease in diameter slightly, ".0011 or ".0008 over the points measured, as the load of 7,000 pounds is applied.
500	.39	
1,000	.45	
1,500	.50	
2,000	.55	
2,500	.61	
3,000	.68	
3,500	.72	
4,000	.80	
4,500	.86	
5,000	.91	
5,500	1.00	
6,000	1.08	
6,500	1.13	
7,000	1.21	
500	.42	

Wheel removed from testing machine.

Deflections of spokes, measured on chord of 18", now: ".02, ".07, ".06, ".06, ".00, ".07, ".05, ".05, ".01, ".07, ".05, ".02, ".05, ".05, ".05, ".04.

Wheel returned to testing machine and loaded in the opposite direction, to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.03	
1,500	.10	
2,000	.18	
2,500	.25	
3,000	.34	
3,500	.42	
4,000	.51	
4,500	.60	
5,000	.70	
5,500	.79	
6,000	.89	
6,500	1.01	
6,800	.....	Wheel creaked.
7,000	1.16	
	1.29	After sustaining load 8 minutes.
500	.68	
Wheel rested 16 hours.		
500	.61	
1,000	.68	
1,500	.71	
2,000	.76	
2,500	.80	
3,000	.85	
3,500	.90	
4,000	.94	
4,500	.99	
5,000	1.04	
5,500	1.09	
6,000	1.14	
6,500	1.21	
7,000	1.29	
500	.68	

Wheel removed from the testing machine.

The spokes were disturbed at the hub end, showing a movement of about ".02 at the circumference of the inner nave box flange. The joints at the tenon ends, at junction of spokes and felloe, were opened on opposite side of wheel from the movement shown at inner ends of the spokes—that is, at the outside face of the wheel. Some of these joints were open prior to the test, but openings were increased during test.

Deflections of spokes, measured on chord of 18", now: ".03, ".09, ".07, ".08, ".02, ".11, ".07, ".09, ".04, ".11, ".06, ".04, ".07, ".07, ".07, ".07.

EHRHARDT, WOODEN, FIELD CARRIAGE WHEEL.

HELIOTYPE CO., BOSTON.

WHEEL No. 11.

EHRHARDT WOODEN WHEEL.

12-spoke wheel for 3-inch Ehrhardt field carriage, received from Sandy Hook proving ground.

Tire, ".43 thick by 2".55 wide; felloe, in three segments, 2".35 deep by 2".57 wide at edge next tire and 2".63 wide at inner edge; weight, 141 pounds. Amount of dishing, ".75.

TEST ON FORCE REQUIRED TO OVERCOME THE DISHING.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.02	
1,500	.05	
2,000	.08	
2,500	.10	
3,000	.14	
3,500	.16	
4,000	.19	
4,500	.21	
5,000	.24	
5,500	.27	
6,000	.30	
6,500	.33	
7,000	.36	
7,500	.41	
8,000	.45	
8,500	.49	
9,000	.53	
9,500	.58	Wheel creaked.
10,000	.67	
500	.13	
10,000	.64	
10,500	.69	
11,000	.75	
11,500	.86	Dishing removed.
12,000	1.00 1.20	After sustaining load 8 minutes.
500	.29	
Spokes show a movement at the circumference of the inner nave-box flange		
500	.27	
1,000	.28	
2,000	.32	
3,000	.38	
4,000	.43	
5,000	.48	
6,000	.53	
7,000	.60	
8,000	.68	
9,000	.78	
10,000	.88	
11,000	1.00	
12,000	1.13	
500	.29	

Wheel removed from testing machine.

Wheel returned to the testing machine and loaded in the opposite direction, to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.03	
1,500	.08	
2,000	.12	
2,500	.18	
3,000	.23	
3,500	.28	
4,000	.33	
4,500	.38	
5,000	.43	
5,500	.48	Wheel creaked.
6,000	.56	
6,500	.61	
7,000	.69	
7,500	.79	
8,000	.91	
8,500	1.01	
9,000	1.19	
500	.49	
1,000	.50	
2,000	.56	
3,000	.62	
4,000	.69	
5,000	.77	
6,000	.85	
7,000	.97	
8,000	1.10	
9,000	1.22	
500	.51	

A movement of the spokes occurred at each end.

EHRHARDT, STEEL, FIELD CARRIAGE WHEEL.
APPEARANCE AFTER TESTING.

HELIOTYPE CO., BOSTON.

WHEEL NO. 12.

EHRHARDT STEEL WHEEL.

14-spoke wheel for 3-inch Ehrhardt field limber, received from Sandy Hook proving ground.

Tire ".43 thick by 2".49 wide; felloe, in two segments, 1".80 deep by 2".48 wide; weight, 144 pounds.

Inner ends of spoke bosses are spread about 4".10 on the length of hub. The bosses of the outer seven spokes are 1".82 outside the plane of the felloe, the bosses of the inner seven spokes being 2".28 inside the plane of the felloe.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	0.	
1,500	.02	
2,000	.04	
2,500	.07	
3,000	.10	
3,500	.12	
4,000	.14	
4,500	.17	
5,000	.19	
5,500	.22	
6,000	.27	
6,500	.30	
7,000	.35	
7,500	.41	
8,000	.49	
8,500	.60	3 spokes partially disabled.
9,000	.78	
9,300	.95 1.30	Ultimate strength.

Three spokes of the inside circle of seven were buckled, and six spokes of the outside circle of seven were loosened at the hub end.

Wheels Nos. 13 to 24, inclusive, groups 3 and 4, had 16 spokes each, with tires ½″ and ⅝″ thick. Three types of outer nave boxes are represented.

Type A has a flange ″.28 thick with a filling ring at the base of the flange fitting the hub portion of the inner nave box. It also fits the hub at the end opposite the flange.

Type B has a flange ″.34 thick, and a bearing on the hub under the flange and at its outer end.

Type C has a flange ″.44 thick and a fit on the hub the same as type B.

THIRD GROUP.

Tests on the resistance of wheels against movement of the rims with reference to the naves.

Rims loaded in four places, equidistant; naves supported at their ends.

WHEEL No. 13.

TYPE A, ½″ TIRE.

Undishing test; cap in place on outer end of hub.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inches.*	
500	0.	Initial load.
1,000	.08	
1,500	.09	
2,000	.13	
2,500	.19	
3,000	.22	
3,500	.28	
4,000	.32	
4,500	.38	
5,000	.42	
5,500	.51	
6,000	.58	Dishing removed.
6,500	.68	
7,000	.76	
7,500	.86	
7,950	1.00	Opening between two spokes and outer nave-box flange, ″.006. No opening shown on 14 spokes.
7,950	1.07	After sustaining load 5 minutes.
500	.31	
1,000	.33	
1,500	.39	
2,000	.44	
2,500	.49	
3,000	.53	
3,500	.59	
4,000	.62	
4,500	.69	
5,000	.73	
5,500	.79	
6,000	.84	
6,500	.89	
7,000	.96	
7,300	1.00	
500	.31	

Test discontinued.

EHRHARDT, STEEL, FIELD CARRIAGE WHEEL. TIRE REMOVED AND WHEEL PARTLY DISJOINTED.

HELIOTYPE CO., BOSTON.

Wheel removed from testing machine, flange bolts loosened, cap removed, and outer flange box backed off. This allowed the dishing to increase ".17 over the amount when the bolts were acting.

Test resumed with no pressure on outside flange.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.04	
1,500	.16	
2,000	.32	
2,500	.50	Dishing removed, plus ".07.
3,000	.69	
3,500	.89	
3,750	1.00	
500	.28	

Supplementary test discontinued.

Tire cut apart and removed from the wheel. Contraction in circumference of the tire with reference to the free diameter of the felloe, ".24. Ends of the tire closed in, overlapping 9".50 when removed from felloe.

Test resumed with tire removed. Flange bolts and hub cap retightened.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.08	
1,500	.12	
2,000	.20	
2,500	.27	
3,000	.34	Dishing removed.
3,500	.41	
4,000	.50	
4,500	.59	Wheel creaked.
5,000	.68	
5,500	.76	
6,000	.88	
6,500	.98	
6,550	1.00	
500	.29	

WHEEL No. 14.

TYPE B, $\frac{1}{2}$" TIRE.

Undishing test; cap in place on outer end of hub.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.04	
1,500	.09	
2,000	.12	
2,500	.19	
3,000	.22	
3,500	.28	
4,000	.32	
4,500	.39	
5,000	.44	
5,500	.52	
6,000	.60	
6,350	.70	Dishing removed.
6,500	.72	
7,000	.81	
7,500	.91	
7,680	1.00	
500	.26	
Flange bolt nuts backed off $\frac{1}{4}$ turn each.		
500	0.	Initial load.
1,000	.06	
1,500	.10	
2,000	.18	
2,500	.25	
3,000	.31	
3,500	.39	
4,000	.47	
4,500	.59	
5,000	.70	
5,500	.82	
6,000	.98	
	1.00	
500	.21	

Wheel removed from the testing machine and nuts retightened with a 14-inch wrench.

Wheel returned to the testing machine and loaded in the opposite direction, to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load
1,000	.06	
1,500	.10	
2,000	.17	
2,500	.22	
3,000	.29	
3,500	.36	
4,000	.42	
4,500	.49	
5,000	.58	
5,500	.66	
6,000	.72	
6,500	.81	
7,000	.90	
7,480	1.00	
500	.38	

WHEEL No. 15.

TYPE C, $\frac{1}{2}''$ TIRE.

Undishing test; cap in place on outer end of hub.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.04	
1,500	.09	
2,000	.12	
2,500	.18	
3,000	.21	
3,500	.27	
4,000	.31	
4,500	.37	
5,000	.41	
5,200	.....	Wheel creaked.
5,500	.49	
6,000	.57	
6,500	.63	Dishing removed.
7,000	.75	
7,500	.84	
8,000	.97	
	1.00	
500	.21	
Flange bolt nuts backed off $\frac{1}{4}$ turn each.		
500	0.	Initial load.
1,000	.05	
1,500	.10	
2,000	.15	
2,500	.20	
3,000	.26	
3,500	.31	
4,000	.38	
4,500	.44	
5,000	.53	
5,500	.65	
6,000	.77	
6,500	.90	
6,720	1.00	
500	.18	
Cap nut on nave box backed off $\frac{1}{4}$ turn, flange bolt nuts remaining backed off as before.		
500	0.	Initial load.
1,000	.06	
1,500	.13	
2,000	.21	
2,500	.30	
3,000	.38	
3,500	.44	
4,000	.51	
4,500	.60	
5,000	.68	
5,500	.76	
6,000	.87	
6,500	.97	
6,650	1.00	
500	.02	

Wheel removed from the testing machine and nuts retightened with a 14-inch wrench, the cap nut also being retightened.

Wheel returned to the testing machine and loaded in the opposite direction, to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.06	
1,500	.10	
2,000	.14	
2,500	.19	
3,000	.22	
3,500	.28	
4,000	.32	
4,500	.38	
5,000	.44	
5,500	.50	
6,000	.58	
6,500	.64	
7,000	.71	Wheel creaked.
7,500	.79	
8,000	.87	
8,500	.98	
8,900	1.00	
500	.29	

WHEEL No. 16.

TYPE A, $\frac{5}{8}$" TIRE.

Undishing test; cap in place on outer end of hub.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.03	
1,500	.10	
2,000	.14	
2,500	.18	
3,000	.23	
3,500	.27	
4,000	.32	
4,500	.38	Dishing removed.
5,000	.43	
5,500	.50	
6,000	.59	
6,500	.68	
7,000	.76	
7,500	.85	
8,000	1.00	
500	.28	
Flange bolt nuts backed off $\frac{1}{4}$ turn each.		
500	0.	Initial load.
1,000	.08	
1,500	.09	
2,000	.14	Dishing removed, plus ".02.
2,500	.20	
3,000	.25	
3,500	.31	
4,000	.38	
4,500	.45	
5,000	.53	
5,500	.68	
6,000	.82	
6,500	1.00	
500	.22	

Wheel removed from the testing machine and nuts retightened with a 14-inch wrench.

Returned to the testing machine and loaded in the opposite direction, to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.06	
1,500	.11	
2,000	.19	
2,500	.26	
3,000	.31	
3,500	.39	
4,000	.46	
4,500	.57	
5,000	.65	
5,500	.76	
6,000	.88	
6,460	1.00	
500	.49	

WHEEL No. 17.

TYPE B, $\frac{3}{8}$" TIRE.

Undishing test; cap in place on outer end of hub.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.05	
1,500	.10	
2,000	.15	
2,500	.20	
3,000	.28	
3,500	.28	
4,000	.31	
4,500	.37	
5,000	.43	
5,500	.50	
6,000	.57	
6,500	.64	
6,900	.70	Dishing removed.
7,000	.75	
7,500	.84	
8,000	.92	
8,300	1.00	
500	.21	
Flange bolt nuts backed off $\frac{1}{4}$ turn each.		
500	0.	Initial load.
1,000	.07	
1,500	.12	
2,000	.17	
2,500	.21	
3,000	.27	
3,500	.32	
4,000	.39	
4,500	.45	
5,000	.52	
5,500	.61	
6,000	.74	
6,500	.91	
6,620	1.00	
500	.12	
Cap nut on nave box backed off $\frac{1}{4}$ turn. Flange bolt nuts remain backed off as before.		
500	0.	Initial load.
1,000	.08	
1,500	.15	
2,000	.21	
2,500	.30	
3,000	.39	
3,500	.45	
4,000	.52	
4,500	.61	
5,000	.70	
5,500	.80	
6,000	.91	
6,340	1.00	
500	.05	

Wheel removed from the testing machine and nuts retightened with a 1¼-inch wrench, also retightening the nave-box cap.

Wheel returned to the testing machine and loaded in the opposite direction, to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.06	
1,500	.10	
2,000	.12	
2,500	.18	
3,000	.22	
3,500	.27	
4,000	.33	
4,500	.39	
5,000	.46	
5,500	.52	
6,000	.60	
6,500	.68	
7,000	.78	
7,500	.86	Wheel creaked.
8,000	.96	
8,280	1.00	
500	.37	

WHEEL No. 18.

TYPE C, $\frac{5}{8}$" TIRE.

Undishing test; cap in place on outer end of hub.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.04	
1,500	.10	
2,000	.12	
2,500	.18	
3,000	.21	
3,500	.27	
4,000	.31	
4,500	.38	
5,000	.43	
5,500	.52	Rested 10 minutes.
6,000	.59	Dishing overcome ".08±.
6,500	.69	
7,000	.76	
7,500	.84	
8,000	.94	
8,100	1.00	
500	.25	
Nuts on flange bolts backed off ¼ turn each.		
500	0.	Initial load.
1,000	.07	
1,500	.12	
2,000	.17	
2,500	.22	
3,000	.29	
3,500	.37	
4,000	.42	
4,500	.51	
5,000	.61	
5,500	.72	
6,000	.86	
6,500	.99 1.01	
500	.30	
Cap nut on nave box backed off ¼ turn. Flange bolt nuts remain backed off as before.		
500	0.	Initial load.
1,000	.07	
1,500	.15	
2,000	.21	
2,500	.30	
3,000	.38	
3,500	.45	
4,000	.52	
4,500	.61	Wheel creaked.
5,000	.70	
5,500	.78	
6,000	.87	
6,500	.96	
6,700	1.00	
500	.10	

Wheel removed from the testing machine and nuts retightened with a 14-inch wrench, also tightening the nave-box cap.

Returned to the testing machine and loaded in the opposite direction, to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.07	
1,500	.11	
2,000	.15	
2,500	.19	
3,000	.23	
3,500	.30	
4,000	.36	
4,500	.41	Wheel creaked.
5,000	.49	
5,500	.54	
6,000	.61	
6,500	.70	
7,000	.79	
7,500	.87	
8,000	.98	
8,250	1.00	
500	.30	

Tire cut apart and removed from the wheel. Contraction of circumference of the tire with reference to the free diameter of the felloe, ".28. Ends of tire overlapped when removed from the felloe, 12".10.

Wheel returned to the testing machine and tested in an undishing direction with tire removed. Flange bolt nuts and hub cap retightened.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.06	
1,500	.12	
2,000	.19	
2,500	.25	
3,000	.31	
3,500	.40	Dishing removed.
4,000	.49	
4,500	.57	Wheel creaked.
5,000	.66	
5,500	.75	
6,000	.86	
6,500	.96	
6,780	1.00	
500	.28	

Wheel removed from the testing machine and flange bolt nuts and hub cap again retightened.

Returned to the testing machine and loaded in the opposite direction, to determine force required to increase dishing.

Applied loads.	Movement of rim with reference to the nave.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.06	
1,500	.13	
2,000	.19	
2,500	.26	Wheel creaked.
3,000	.33	
3,500	.42	
4,000	.49	
4,500	.58	
5,000	.67	
5,500	.75	
6,000	.83	
6,500	.95	
6,850	1.00	
500	.25	

FOURTH GROUP.

Tests on the resistance of wheels against movement of the rims with reference to the naves.

Rims loaded in one place.

The wheels of this group, by request, had the nave box flange bolts loose when received for testing.

WHEEL No. 19.

Type A, $\frac{1}{2}$" tire.

Flange bolts tightened before testing. Hub cap tight.

Dishing of wheel, 1".07.

Applied loads.	Measurement.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inches.*	
200	0.	0.	Initial load.
500	.03	.07	Measurements A show the movement of the rim with reference to the nave at the bottom of the wheel, at the place where the rim was loaded.
800	.29	.12	
1,000	.37	.16	
1,500	.61	.27	Measurements B show the accompanying movements of the rim at the top of the wheel, diametrically opposite the place loaded. The movement here is in the opposite direction to that at A.
2,000	.90	.38	
200	.10	.03	
2,300	1.04	.45	
2,500	1.17	.49	
2,800	1.36	.58	
3,000	1.50	.63	
200	.30	.10	
3,200	1.66	.70	
3,500	1.90	.81	
3,800	2.24	.94	
4,000	2.41	1.01	
200	.63	.26	

Test discontinued.

Wheel rotated one-half turn and test resumed.

3 INCH FIELD CARRIAGE WHEEL, TESTED BY LOAD APPLIED TO RIM AT ONE PLACE.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inches.*	
200	0.	0.	Initial load.
500	.12	.07	
800	.29	.15	
1,000	.40	.20	
1,500	.69	.34	
2,000	1.00	.50	
200	.18	.25	
2,300	1.20	.60	
2,500	1.36	.67	
2,800	1.60	.78	
3,000	1.77	.83	
200	.40	.30	
3,200	1.91	.90	
3,500	2.27	1.05	
3,800	2.57	1.15	
4,000	2.80	1.24	
200	.74	.46	

Test discontinued.

Under 4,000 pounds load the 5 lower spokes of the wheel were in the same plane, approximately. The other 11 spokes occupied positions more or less dishing, those having the most conicity being at the upper part of the wheel. The conicity of the upper spokes was increased somewhat at the time the lower ones were undished.

WHEEL No. 20.

Type A, $\frac{5}{8}$" tire.
Flange bolts tightened before testing. Hub cap tight.
Dishing of wheel, ".58.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inch.*	
200	0.	0.	Initial load.
500	.12	.04	
800	.26	.11	
1,000	.35	.15	
1,500	.57	.25	
2,000	.81	.36	
200	.09	.03	
2,000	.91	.40	
2,500	1.11	.47	
2,800	1.33	.55	
3,000	1.45	.60	
200	.23	.09	
3,200	1.61	.67	
3,500	1.90	.77	
3,800	2.25	.90	
4,000	2.50	.99	
200	.61	.22	

Test discontinued.
Wheel rotated one-half turn and test resumed.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inches.*	
200	0.	0.	Initial load.
500	.19	.08	
800	.30	.15	
1,000	.42	.20	
1,500	.68	.33	
2,000	.95	.49	
200	.16	.15	
2,200	1.08	.55	
2,500	1.26	.64	
2,800	1.48	.73	
3,000	1.54	.81	
200	.33	.30	
3,200	1.78	.87	
3,500	2.07	1.00	
3,800	2.39	1.10	
4,000	2.67	1.19	
200	.69	.46	

Test discontinued.

WHEEL No. 21.

Type B, ½" tire.
Flange bolts tightened before testing. Hub cap tight.
Dishing of wheel, ".62.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inch.*	
200	0.	0.	Initial load.
500	.12	.04	
800	.23	.09	
1,000	.35	.14	
1,500	.57	.24	
2,000	.80	.33	
200	.09	.04	
2,200	.90	.37	
2,500	1.09	.44	
2,800	1.28	.50	
3,000	1.40	.53	
200	.28	.09	
3,200	1.57	.58	
3,500	1.75	.65	
3,800	2.00	.72	
4,000	2.20	.77	
200	.50	.16	

Test discontinued.
Wheel rotated one-half turn and test resumed.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inch.*	
200	0.	0.	Initial load.
500	.15	.07	
800	.29	.13	
1,000	.39	.17	
1,500	.61	.29	
2,000	.88	.40	
500	.12	.12	
2,200	.98	.42	
2,500	1.19	.55	
2,800	1.38	.60	
3,000	1.50	.65	Creaked.
200	.31	.22	
3,200	1.64	.68	
3,500	1.89	.82	
3,800	2.19	.92	
4,000	2.39	.98	
200	.60	.40	

Test discontinued.

WHEEL No. 22.

Type B, $\frac{5}{8}$" tire.
Flange bolts tightened before testing. Hub cap tight.
Dishing of wheel, ".62.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inch.*	
200	0.	0.	Initial load.
500	.12	.04	
800	.23	.12	
1,000	.34	.14	
1,500	.57	.29	
2,000	.82	.38	
200	.09	.05	
2,200	.91	.39	
2,500	1.11	.48	
2,800	1.30	.53	
3,000	1.43	.59	
200	.22	.09	
3,200	1.59	.64	
3,500	1.81	.74	Creaked.
3,800	2.10	.83	
4,000	2.37	.90	
200	.59	.19	

Test discontinued. Wheel rotated one-half turn and test resumed.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inches.*	
200	0.	0.	Initial load.
500	.17	.10	
800	.33	.18	
1,000	.42	.25	
1,500	.68	.36	
2,000	.91	.45	
200	.17	.18	
2,300	1.01	.58	
2,500	1.21	.62	
2,800	1.39	.70	
3,000	1.52	.75	
200	.31	.26	
3,200	1.68	.80	
3,500	1.90	.90	
3,800	2.20	1.00	
4,000	2.40	1.10	
200	.60	.40	

Test discontinued.

WHEEL No. 23.

Type C, ½" tire.
Flange bolts tightened before testing. Hub cap tight.
Dishing of wheel, ".58.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inch.*	
200	0.	0.	Initial load.
500	.15	.06	
800	.29	.10	
1,000	.36	.13	
1,500	.60	.23	
2,000	.89	.33	
200	.09	.01	
2,200	1.01	.37	
2,500	1.20	.43	
2,800	1.41	.48	
3,000	1.43	.54	
200	.21	.08	
3,200	1.69	.58	
3,500	1.93	.66	
3,800	2.20	.73	
4,000	2.40	.78	
200	.49	.13	

Test discontinued.
Wheel rotated one-half turn and test resumed.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inches.*	
200	0.	0.	Initial load.
500	.16	.07	
800	.30	.13	
1,000	.39	.19	
1,500	.61	.30	
2,000	.91	.43	
200	.17	.13	
2,200	1.08	.49	
2,500	1.29	.57	
2,800	1.49	.65	
3,000	1.64	.70	
200	.32	.23	
3,200	1.80	.75	
3,500	2.09	.84	
3,800	2.40	.96	
4,000	2.69	1.08	
200	.67	..38	

Test discontinued.

Wheel No. 24.

Type C, $\frac{5}{8}$" tire.
Flange bolts tightened before testing. Hub cap tight.
Dishing of wheel, ".53.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inch.*	
200	0.	0.	Initial load.
500	.16	.05	
800	.29	.11	
1,000	.39	.15	
1,500	.62	.26	
2,000	.88	.38	
200	.09	.03	
2,200	.99	.40	
2,500	1.18	.49	
2,800	1.37	.56	
3,000	1.50	.61	
200	.22	.08	
3,200	1.62	.66	
3,500	1.83	.74	
3,800	2.10	.84	
4,000	2.30	.90	
200	.48	.18	

Test discontinued. Wheel rotated one-half turn and test resumed.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inches.*	
200	0.	0.	Initial load.
500	.15	.06	
800	.30	.14	
1,000	.39	.20	
1,500	.62	.31	
2,000	.89	.48	
200	.15	.12	
2,200	.99	.51	
2,500	1.17	.59	
2,800	1.34	.66	
3,000	1.49	.71	
200	.31	.22	
3,200	1.65	.80	
3,500	1.85	.88	
3,800	2.10	.99	
4,000	2.31	1.06	
200	.58	.35	

Test discontinued. Nuts on flange bolts and hub cap backed one-half turn each and test resumed. Wheel in same position as during last loading.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inches.*	
200	0.	0.	Initial load.
500	.20	.09	
800	.41	.24	
1,000	.58	.34	
1,500	.94	.54	
2,000	1.31	.76	
200	.20	.18	
2,200	1.50	.85	
2,500	1.71	.96	
2,800	2.00	1.08	
3,000	2.20	1.18	
200	.40	.34	
3,200	2.42	1.28	
3,500	2.79	1.50	
3,800	3.20	1.54	
4,000	3.43	1.60	
200	.87	.55	

Test discontinued.

TEST OF A WHEEL WITHOUT A TIRE.

Spokes and rim of wheel No. 18 assembled with hub of No. 24. Flange bolts and cap nut tight.

Applied loads.	Measurements.		Remarks.
	A.	B.	
Pounds.	*Inches.*	*Inch.*	
200	0.	0.	Initial load.
500	.20	.04	
800	.39	.06	
1,000	.52	.07	
1,500	.90	.08	
2,000	1.38	.09	
200	.28	0.	
2,200	1.60	.09	Creaked.
2,500	1.99	.10	
2,800	2.42	.10	
3,000	2.90	.....	
200	.91	.....	
3,200	3.49	.....	
3,400	5.20	.....	
200	2.73	.....	

Test discontinued.

TEST OF SINGLE SPOKES BETWEEN HUB FLANGES. HUB FROM WHEEL NO. 24.

Two flange bolts set up tight, one on each side of spoke. Cap nut and two bolts in place on opposite side of flange.

FIRST SPOKE.

Applied loads.	Measurement at outer end.		Remarks.
	Deflection.	Set.	
Pounds.	*Inches.*	*Inch.*	
100	0.	0.	Initial load.
200	.12	.01	
300	.29	.03	
400	.46	.08	
500	.63	.12	
600	.91	.25	
700	1.31	.49	

SECOND SPOKE.

Tested between the flanges in same place as first spoke.

100	0.	0.	Initial load.
200	.15	0.	
300	.31	.01	
400	.50	.04	
500	.75	.12	
600	1.02	.22	
700	1.40	.39	

THIRD SPOKE.

Tested between the flanges in the same place as first spoke.

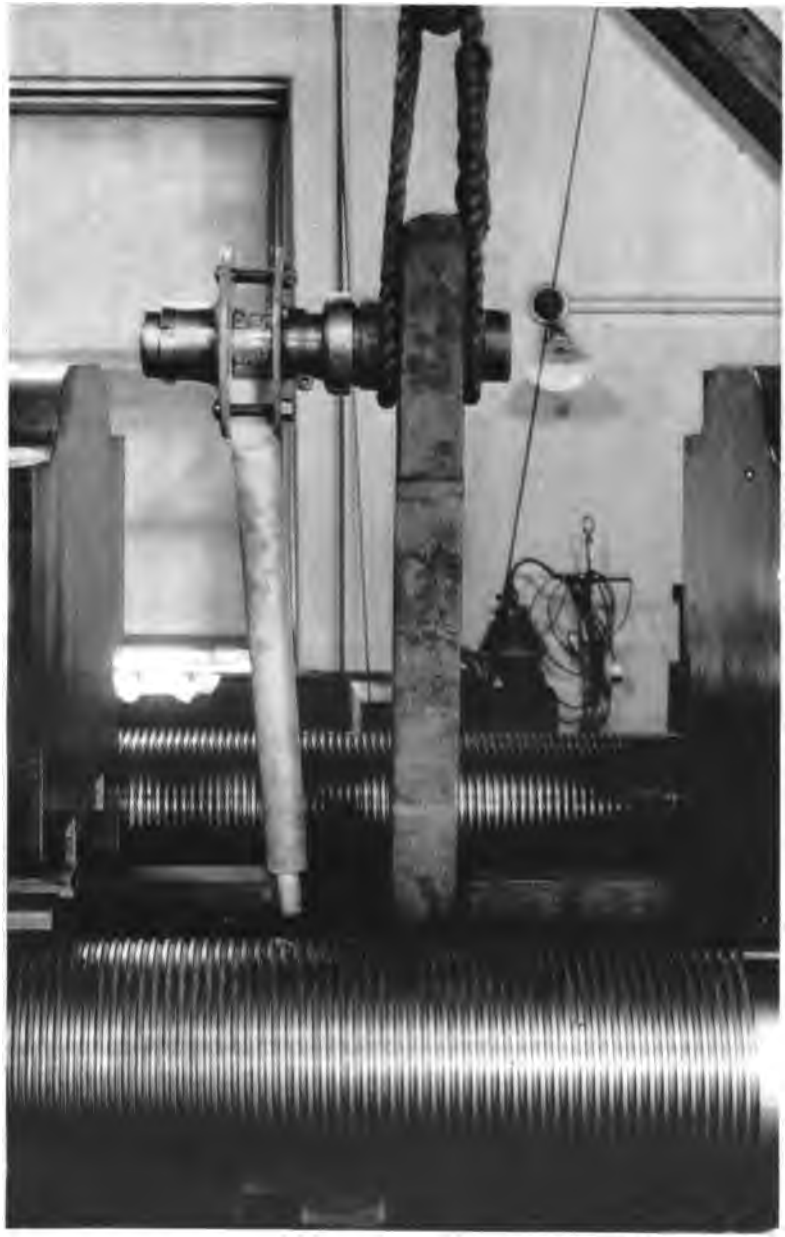
100	0.	0.	Initial load.
200	.21	0.	
300	.47	.05	
400	.71	.11	
500	1.01	.20	
600	1.40	.30	
700	1.94	.57	

ADDITIONAL DATA, THIRD SPOKE.

A straightedge, resting against brads driven in the outer face, was used for reference purposes to show the deflection of the spoke, measured at the felloe end, independent of the hub.

The brads were located 18″ and 20″, respectively, from the felloe end of the spoke.

Applied loads.	Deflection.	Remarks.
Pounds.	*Inch.*	
100	0.	Initial load.
200	.13	
300	.30	
400	.48	
500	.60	
600	.77	
700	.94	
100	.07	



3-INCH FIELD CARRIAGE WHEEL.
SINGLE SPOKE TEST.

HELIOTYPE CO., BOSTON

FOURTH SPOKE.

Measurements of deflection were made at two places. Those at A show the total movement at the felloe end of the spoke with reference to the nave box; those at C, the deflection with reference to a straight-edge held in the same manner as for the third spoke.

Applied loads.	A.		C.		Remarks.
	Deflection.	Set.	Deflection.	Set.	
Pounds.	*Inches.*	*Inches.*	*Inch.*	*Inch.*	
100	0.	0.	0.	0.	
200	.08	.01	.10	0.	
300	.28	.03	.14	0.	
400	.42	.07	.20	0.	
500	.61	.16	.27	0.	
600	.89	.28	.34	0.	
700	1.29	.53	.42	0.	
780	3.84	2.10	.48	.02	

TEST ON THE EFFICIENCY OF THE "ARCH" ACTION OF THE SPOKES AT HUB END.

Rim, spokes, and tire of wheel No. 24 intact, with hub removed. Loaded diametrically in an inward direction.

Applied loads.	Diametrical movement.	Remarks.
Pounds.	*Inch.*	
200	0.	Initial load.
500	0.	
800	0.	
1,000	.01	
1,500	.02	
2,000	.03	
2,300	.05	
2,500	.08	1 spoke shows inward radial movement.
2,600	.09	
2,700	.09	
2,800	.16	3 spokes have taken inward movement.
3,000	.16	
3,100	.23	7 spokes disturbed in position.
3,200	.23	
3,300	.30	
200	.25	

STRAINS IN THE TIRES.

Table showing changes in length of tires when cut apart, with reference to their released condition and the felloes of the wheels, when both tire and felloe are relieved of shrinkage strains. Also, the distance the free ends of the tires overlapped each other after cutting apart and having been removed from the wheel:

Number of wheel.	Expansion at cut.	Free ends overlap.	Number of wheel.	Expansion at cut.	Free ends overlap.
	Inch.	*Inches.*		*Inch.*	*Inches.*
1	0.15	11.75	7	0.09	None.
2	.13	18.00	8	.13	22.00
3	.29	10.25	9	.38	18.25
4	.20	17.75	10	.25	10.60
5	.24	15.00	11	.16	11.18
6	.23	18.00	12	.34	2.75

TENSILE TESTS OF METAL FROM TIRES AND HUBS.

TENSILE TESTS OF METAL FROM THE TIRES, STEEL.

PLAIN SPECIMENS, WITHOUT WELDS.

Number of wheel.	Dimensions. Width.	Dimensions. Thickness.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 5″.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Inches.	*Inch.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pr. ct.*	*Pr. ct.*	″ ″ ″ ″ ″	
1	1.507	.502	.7565	45,700	67,280	27.8	52.9	.12, .18, .24, .68*, .17	Fine silky.
1	1.507	.503	.7580	45,900	67,020	27.0	54.8	.15, .14, .19, .68*, .19	Do.
2	1.510	.486	.7338	41,000	72,090	28.8	41.6	.18, .43*, .41, .25, .17	Do.
2	1.509	.488	.7363	41,300	73,070	24.0	40.2	.22, .48*, .18, .18, .14	Do.
3	1.495	.377	.5636	40,500	63,500	27.8	55.9	.18, .18, .61*, .24, .18	Do.
3	1.506	.375	.5647	42,000	65,520	20.0	57.1	.60*, .13, .12, .07, .08	Do.
4	1.495	.380	.5681	61,800	84,840	20.0	40.9	.14, .47*, .13, .12, .14	Do.
4	1.506	.380	.5723	60,800	84,400	17.4	36.6	.12, .24*, .33*, .09, .09	Do.
5	1.497	.505	.7560	55,700	80,420	22.4	43.7	.16, .54*, .14, .15, .13	Do.
5	1.506	.505	.7605	55,000	78,110	20.0	46.0	.12, .56*, .12, .09, .11	Do.
6	1.496	.510	.7630	59,000	80,210	19.8	50.1	.09, .13, .54*, .10, .13	Do.
6	1.496	.510	.7630	56,400	76,670	22.4	46.2	.12, .13, .21, .54*, .12	Do.
7	1.503	.368	.5831	42,100	61,470	27.2	52.3	.12, .21, .60*, .21, .22	Do.
7	1.503	.371	.5576	42,000	61,150	24.4	51.2	.13, .49*, .35*, .14, .11	Do.
8	1.506	.372	.5602	60,900	81,580	17.2	43.1	.47*, .11, .10, .10, .08	Do.
8	1.499	.373	.5591	62,100	84,240	18.2	42.5	.10, .11, .33*, .27*, .10	Do.
9	1.497	.495	.741	46,290	68,560	26.0	51.7	.12, .13, .20, .62*, .23	Silky.
9	1.496	.495	.741	48,720	70,450	24.0	43.6	.53*, .25, .17, .14, .11	Do.
10	1.503	.503	.756	52,250	75,930	22.0	43.3	.12, .14, .14, .53*, .17	Do.
10	1.500	.500	.750	52,400	78,130	18.6	39.2	.12, .09, .21, .40*, .11	Do.
11	1.493	.428	.639	61,350	101,880	19.2	33.2	.15, .35*, .25, .12, .11	Do.
11	1.501	.431	.647	57,190	102,160	21.4	37.7	.12, .15, .35*, .31*, .14	Do.
12	1.501	.431	.647	54,100	90,260	19.2	42.7	.09, .10, .11, .36*, .30*	Do.
12	1.495	.443	.662	50,600	90,030	24.4	47.1	.15, .15, .18, .56*, .18	Do.

TENSILE TESTS OF METAL FROM TIRES AND HUBS—Continued.

TENSILE TESTS OF METAL FROM THE TIRES, STEEL—Continued.

SPECIMENS CONTAINING WELDED JOINTS.

Number of wheel.	Length of scarf.	Dimensions. Width.	Dimensions. Thickness.	Sectional areas.	Tensile strength per square inch.	Description of fracture.
	Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	
1	2.50	2.89	.52	1.503	49,100	Along the scarf.
2	2.85	2.78	.51	1.418	48,800	Do.
5	2.00	2.99	.52	1.555	49,900	At end of scarf. Granular.
6	2.00	3.00	.50	1.500	39,400	Do.
7	2.10	3.00	.37	1.110	51,000	6″ from weld. Granular.
8	2.50	2.97	.39	1.158	57,300	At end of scarf. Granular.
9	2.25	2.98	.50	1.490	61,740	Do.
10	2.00	2.98	.50	1.490	51,140	Along the scarf.
11	.....	2.56	.42	1.075	80,470	Position of weld, if any existed, was uncertain. This specimen fractured across a tire bolt-hole ″.44 diameter, with ″.75 countersink. Appearance, silky.
12	.....	2.51	.48	1.205	82,990	Position of weld, if any existed, was uncertain. This specimen resisted 100,000 pounds tension without fracture. This tire was turned on both inside and outside surfaces. It had no tire bolts, but was retained in place over the felloe by its shrinkage, aided by a slight flange on the inside at each end.

TENSILE TESTS OF SPECIMENS FROM THE HUBS, STEEL.

SPECIMENS TAKEN OUT AFTER TESTS OF WHEELS AND NAVE BOX FLANGES.

Number of wheel.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Percent.*	*Per ct.*		
3	.275	.059	40,680	78,310	32.0	61.0	.32*	Fine silky, cup-shaped.
3	.275	.059	41,530	77,290	33.0	61.0	.33*	Do.
3	.275	.059	40,850	78,810	32.0	61.0	.32*	Do.
4	.275	.059	51,860	93,900	30.0	52.5	.30*	Do.
4	.275	.059	52,540	92,880	30.0	57.6	.30*	Do.
4	.275	.059	50,850	93,060	29.0	52.5	.29*	Do.
5	.275	.059	40,680	81,530	11.0	23.7	.11	Silky, irregular.
5	.275	.059	45,760	77,970	10.0	23.7	.10	Do.
5	.275	.059	42,370	77,970	11.0	23.7	.11	Do.

TENSILE TESTS OF SPECIMENS FROM THE HUBS, MALLEABLE IRON.

SPECIMENS TAKEN OUT AFTER TESTS OF WHEELS AND NAVE BOX FLANGES.

Number of wheel.	Diameter.	Sectional area.	Tensile strength. Total.	Tensile strength. Per square inch.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	
1	.505	.20	3,100	15,500	Dark gray, amorphous, spongy.
1	.505	.20	2,300	11,500	Do.
1	.505	.20	4,300	21,500	Do.
2	.505	.20	7,100	35,500	Dark gray, amorphous.
2	.505	.20	3,000	15,000	Dark gray, amorphous, spongy.
2	.505	.20	7,200	36,000	Dark gray, amorphous.

CHEMICAL ANALYSES OF METAL FROM THE TIRES.

Number of wheel.	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
5	.11	.51	.005	.098	.087
7	.08	.52	.005	.175	.081
8	.12	.70	.005	.085	.082

TESTS TO DETERMINE STRENGTH OF NAVE-BOX FLANGES.

Ultimate strength was determined of nave-box flanges of wheels Nos. 1, 2, and 10. All other ultimate strengths indicate an arbitrary point at which the dishing amounted to about $\frac{1}{4}$", measured on the testing ring.

Number of wheel.	Nave box.	Dimensions.		Width of annular bearing.	Load required to cause dishing of ".02.	Ultimate strength.	Remarks.
		Exterior diameter.	Thickness.				
		Inches.	*Inch.*	*Inch.*	*Pounds.*	*Pounds.*	
1	Outer...	10.48	.65	$\frac{13}{16}$	65,000	99,100	
1	Inner...	10.64	.85	$\frac{7}{8}$	.....	147,000	
2	Outer...	10.00	.58	$\frac{9}{16}$	44,000	67,600	
2	Inner...	10.13	.61	$\frac{3}{4}$	.....	74,100	
3	Outer...	9.28	.28	$\frac{1}{4}$	16,500	33,000	
3	Inner...	9.28	.34	$\frac{1}{4}$	28,000	75,100	Decided yielding at 28,000 pounds.
4	Outer...	9.28	.28	$\frac{1}{4}$	18,500	31,000	
4	Inner...	9.28	.34	$\frac{1}{4}$	26,000	83,000	
5	Outer...	9.28	.28	$\frac{1}{4}$	18,100	27,500	
5	Inner...	9.28	.34	$\frac{1}{4}$	24,000	80,500	
6	Outer...	9.28	.28	$\frac{1}{4}$	21,000	32,800	At 30,000 pounds fractures developed at the square corners of 6 of the bolt holes in the flange. Loads were continued after passing the maximum resistance of 33,000 pounds, developing additional lines of fracture, the appearance of which was granular.
6	Inner...	9.28	.34	$\frac{1}{4}$	27,000	84,000	
7	Outer...	9.28	.28	$\frac{1}{4}$	20,200	32,500	Outer nave box flange was permanently distorted prior to test.
7	Inner...	9.28	.34	$\frac{1}{4}$	.....	76,000	Inner nave box flange was permanently distorted prior to test, having about ".07 dishing at one point on the rim.
8	Outer...	9.28	.28	$\frac{1}{4}$	16,000	26,000	
8	Inner...	9.27	.34	$\frac{1}{4}$	26,000	71,000	
9	Outer...	9.26	.28	$\frac{1}{4}$	13,800	61,000	
9	Inner...	9.26	.34	$\frac{1}{4}$	27,300	93,000	
10	Outer...	9.50	.56	$\frac{1}{4}$	.....	35,900	Cast-iron box; fractured under 35,900 pounds without showing observable change in the dishing prior to rupture.
10	Inner...	9.54	.70	$\frac{1}{4}$	.....	53,100	Cast-iron box; fractured under 53,100 pounds without showing observable change in the dishing prior to rupture.
11	Inner...	11.87	.27 / .28	$\frac{1}{4}$	14,100	66,000	Initial dishing in reverse direction, ".25.
11	Outer...	11.87	.27 / .24	$\frac{1}{4}$	12,800	99,000	Initial dishing in reverse direction, ".22.
18	Outer...	9.28	.44	$\frac{1}{4}$	35,800	105,000	

CORDAGE.

LINEN SHOT LINES FOR THE UNITED STATES LIFE-SAVING SERVICE.

No. 9 Shot Lines.

Three strands of 16 threads each.
Diameter, ".31.
Lay, 1 turn in ".83 to ".90.
Weights include sisal straps.

No.	Weight of coil.	End of coil tested.	Tensile strength.	Parted.
	Lbs. *oz.*		*Pounds.*	
1	35 8	Outside...	1,320	1 strand at the pin.
2	35 8	.....do....	1,340	Do.
3	34 8	.....do....	1,410	Do.
4	35 8	.....do....	1,380	Do.
5	36 4	.....do....	1,320	3 strands at the pin.
6	35 8	.....do....	1,080	1 strand at the pin.
7	35 4	.....do....	1,210	Do.
8	35 12	.....do....	1,350	Do.
9	36 4	.....do....	1,220	Do.
10	35 8	.....do....	1,440	2 strands at the pin.
11	35 0	Inside....	1,330	1 strand at the middle.
12	33 12	Outside...	1,120	1 strand at the pin.
13	36 4	.....do....	1,250	2 strands at the pin.
14	35 8	.....do....	1,310	1 strand at the pin.
15	35 4	.....do....	1,370	2 strands at the pin.
16	35 12	.....do....	1,440	1 strand at the pin.
17	34 12	.....do....	1,230	Do.
18	35 8	.....do....	1,240	Do.
19	35 12	.....do....	1,330	Do.
20	35 0	.....do....	1,320	Do.
21	35 4	.....do....	1,350	Do.
22	35 8	Inside....	1,460	Do.
23	35 4	.....do....	1,360	1 strand at the middle.
24	35 4	.....do....	1,310	1 strand at the pin.
25	35 12	Outside...	1,440	3 strands at the pin.
26	35 12	.....do....	1,350	1 strand at the pin.
27	36 0	.....do....	1,310	Do.
28	35 8	.....do....	1,360	1 strand 3 inches from pin.
29	36 0	Inside....	1,340	1 strand 6 inches from pin.
30	35 8	Outside...	1,320	1 strand at the pin.
31	35 12	Inside....	1,080	Do.
32	36 0	Outside...	1,430	Do.
33	35 12	.....do....	1,310	2 strands at the pin.
34	35 12	Inside....	1,280	1 strand at the pin.
35	34 12	Outside...	1,310	Do.
36	35 0	.....do....	1,340	Do.
37	35 0	.....do....	1,390	Do.
38	35 8	.....do....	1,330	Do.
39	36 0	.....do....	1,380	Do.
40	35 8	Inside....	1,370	1 strand 24 inches from pin.
41	35 12	Outside...	1,330	1 strand at the pin.
42	36 0	.....do....	1,280	Do.
43	35 8	.....do....	1,510	Do.
44	35 12	.....do....	1,220	Do.
45	35 12	.....do....	1,320	2 strands at the pin.
46	35 12	.....do....	1,360	1 strand at the pin.
47	35 8	.....do....	1,240	Do.
48	36 4	.....do....	1,390	Do.
49	35 8	.....do....	1,250	Do.
50	35 12	.....do....	1,410	Do.

ADDITIONAL TESTS.

6a	.....	Outside...	1,230	3 strands at the middle.
31a	.....	.....do....	1,240	1 strand at the middle.
[a]31b	.....	.....do....	1,520	1 strand 18 inches from pin.

[a] Wet sample.

No. 7 Shot Lines.

Three strands of 9 threads each.
Diameter, ".23.
Lay, 1 turn in ".50 to ".85.
The extreme case of hard twist observed occurred in coil No. 72.

No.	Weight of coil.	End of coil tested.	Tensile strength.	Parted.
	Lbs. oz.		*Pounds.*	
51	21 0	Outside...	440	1 strand 5" from pin.
52	21 0	.....do....	710	3 strands at the middle.
53	20 8	.....do....	820	3 strands at the pin.
54	20 12	.....do....	760	Do.
55	21 0	.....do....	820	2 strands at the pin.
56	21 0	.....do....	740	1 strand 20" from pin.
57	21 0	.....do....	710	1 strand 18" from pin.
58	20 12	.....do....	640	1 strand 4" from pin.
59	20 12	.....do....	730	3 strands at the pin.
60	21 4	Inside	980	1 strand at the middle.
61	21 0	Outside...	770	3 strands at the pin.
62	20 12	.....do....	760	2 strands at the pin.
63	21 0	.....do....	880	1 strand 15" from pin.
64	21 0	.....do....	760	2 strands 9" from pin.
65	21 0	.....do....	580	2 strands 3" from pin.
66	20 12	.....do....	710	1 strand at the pin.
67	20 12	Inside	870	Do.
68	21 0	Outside...	870	2 strands at the pin.
69	21 0	.....do....	610	1 strand at the middle.
70	21 0	Inside	910	2 strands 3" from pin.
71	21 0	Outside...	660	3 strands at the pin.
72	21 0	Inside	810	2 strands 8" from pin.
73	21 0	Outside...	640	2 strands 2" from pin.
74	20 12	.....do....	720	3 strands at the pin.
75	20 12	.....do....	770	Do.
76	20 8	.....do....	720	1 strand 25" from pin.
77	21 0	.....do....	680	2 strands 5" from pin.
78	20 12	.....do....	570	1 strand 21" from pin.
79	20 12	.....do....	680	1 strand at the pin.
80	21 0	.....do....	770	Do.
81	20 12	Inside	850	3 strands at the pin.
82	21 0	Outside...	610	1 strand 19" from pin.
83	21 0	Inside	590	1 strand 3" from pin.
84	20 12	Outside...	470	2 strands 3" from pin.
85	21 0	.....do....	740	2 strands at the pin.
86	20 12	.....do....	730	Do.
87	20 12	Inside	860	1 strand 2" from pin.
88	20 12	Outside...	820	3 strands at the pin.
89	20 8	Inside	770	1 strand 24" from pin.
90	20 8	Outside...	810	1 strand 9" from pin.
91	20 8	.....do....	710	1 strand at the pin.
92	20 8	.....do....	880	1 strand 12" from pin.
93	20 8	.....do....	690	3 strands 16" from pin.
94	21 0	.....do....	760	3 strands at the pin.
95	20 12	.....do....	750	2 strands at the pin.
96	20 12	.....do....	740	1 strand 14" from pin.
97	21 0	.....do....	630	3 strands at the pin.
98	20 12	.....do....	790	Do.
99	20 12	.....do....	870	1 strand at the pin.
100	20 12	.....do....	760	2 strands at the pin.

ADDITIONAL TESTS.

51a	.....	Outside...	720	3 strands 21" from pin.
65a	.....	.....do....	630	1 strand 21" from pin.
78a	.....	.....do....	820	1 strand 25" from pin.
84a	.....	.....do....	580	1 strand at the pin.
84b	.....	.....do....	420	2 strands at the middle.
[a]61a	.....	.....do....	740	1 strand at the pin.
84c	.....	.....do....	730	3 strands 26" from pin.
84d	.....	Inside	720	2 strands at the pin.

[a] Hard twisted 1 turn in ".58.

No. 4 Shot Lines.

Three strands of 4 threads each.
Diameter, ".15.
Lay, 1 turn in ".60.

Number.	Weight of coil.	End of coil tested.	Tensile strength.	Parted.
	Lbs. *oz.*		*Pounds.*	
101	10 4	Outside...	330	3 strands at the middle.
102	10 6	.....do....	320	2 strands 24" from pin.
103	10 4	.....do....	340	2 strands 6" from pin.
104	10 8	.....do....	360	3 strands 14" from pin.
105	10 8	.....do....	360	3 strands 5" from pin.
106	10 7	.....do....	340	1 strand 12" from pin.
107	10 5	.....do....	362	3 strands 22" from pin.
108	10 6	.....do....	345	3 strands at the middle.
109	10 6	Inside....	420	3 strands 4" from pin.
110	10 6	Outside...	370	3 strands at the pin.
111	10 6	.....do....	280	3 strands 25" from pin.
112	10 3	.....do....	320	3 strands 4" from pin.
113	10 5	.....do....	330	1 strand 14" from pin.
114	10 4	.....do....	394	3 strands at the pin.
115	10 3	.....do....	365	1 strand at the middle.
116	10 5	.....do....	344	3 strands 12" from pin.
117	10 5	.....do....	340	3 strands at the pin.
118	10 5	.....do....	250	Do.
119	10 5	.....do....	410	3 strands at the middle.
120	10 4	.....do....	372	2 strands 6" from pin.
121	10 6	Inside....	395	3 strands 4" from pin.
122	10 4	Outside...	365	3 strands 20" from pin.
123	10 6	.....do....	270	2 strands 15" from pin.
124	10 6	.....do....	310	3 strands at the middle.
125	10 3	.....do....	415	2 strands at the middle.
126	10 4	.....do....	360	3 strands at the pin.
127	10 3	.....do....	355	2 strands 8" from pin.
128	10 6	.....do....	380	3 strands at the pin.
129	10 5	.....do....	330	3 strands 20" from pin.
130	10 6	.....do....	290	3 strands 21" from pin.
131	10 6	.....do....	360	3 strands 26" from pin.
132	10 6	Inside....	360	3 strands at the pin.
133	10 6	Outside...	320	3 strands 15" from pin.
134	10 3	.....do....	280	2 strands 24" from pin.
135	10 7	.....do....	260	1 strand 15" from pin.
136	10 9	Inside....	390	3 strands 24" from pin.
137	10 5	Outside...	350	3 strands 8" from pin.
138	10 7	Inside....	360	Do.
139	10 7	Outside...	340	2 strands 3" from pin.
140	10 5	.....do....	260	3 strands at the middle.
141	10 4	.....do....	320	Do.
142	10 5	.....do....	240	Do.
143	10 5	.....do....	330	Do.
144	10 5	.....do....	300	3 strands 12" from pin.
145	10 6	Inside....	395	2 strands 9" from pin.
146	10 3	.....do....	340	2 strands 7" from pin.
147	10 6	Outside...	280	3 strands at the pin.
148	10 5	Inside....	410	1 strand 14" from pin.
149	10 6	Outside...	350	2 strands 24" from pin.
150	10 6	.....do....	380	3 strands at the pin.

ADDITIONAL TESTS.

140a	.....	.....	230	1 strand 22" from pin.
135a	.....	.....	270	2 strands 22" from pin.
147a	.....	.....	330	2 strands at the middle.
111a	.....	.....	310	3 strands 19" from pin.
118a	.....	.....	320	3 strands 24" from pin.
123a	.....	.....	310	1 strand 12" from pin.
142a	.....	.....	290	3 strands 6" from pin.
134a	.....	.....	280	3 strands 18" from pin.
130a	.....	.....	360	3 strands 20" from pin.

Remarks.—Coil No. 84 was discolored, having a darker color on one side over a length of 7" and penetrating to the third, and in places to the fourth layer.

TESTS OF INDIVIDUAL YARNS.

No. 9 LINE.

Coil 43.
Length between hooks, 6″.

Yarns from the—		
First strand.	Second strand.	Third strand.
Pounds.	*Pounds.*	*Pounds.*
30.5	32.5	29.5
26	27	30
31	32	28.5
28.5	25	29
29	31	35.5
30	32.5	31
29	25	29
31.5	30	27.5
26	33.5	28.5
36	30.5	28
32	27.5	20.5
32.5	35.5	25
31	32.5	32.5
32	24	28
33	34	21.5
30	30.5	32.5
488	483	456.5

Total, 1,427.5 pounds.

No. 7 LINE.

Coil 72.
Length between hooks, 6″.

Yarns from the—		
First strand.	Second strand.	Third strand.
Pounds.	*Pounds.*	*Pounds.*
23	22.5	22
27	25	29
28	29.5	31.5
22	23.5	35
26	26	33
22	25.5	22.5
26.5	24	29
22	28	25.5
28.5	27	30
223	231	257.5

Total, 711.5 pounds.

No. 4 Lines.

Coil 125.
Length between hooks, 6″.

Yarns from the—		
First strand.	Second strand.	Third strand.
Pounds.	*Pounds.*	*Pounds.*
27.5	29.5	26.5
30	36	29.5
27	34.5	22
29.5	27.5	26
114	127.5	104

Total, 345.5 pounds.

Coil 125.
Length between hooks, 12″.

Yarns from the—		
First strand.	Second strand.	Third strand.
Pounds.	*Pounds.*	*Pounds.*
24	24	24.5
23	25.5	27
24	33	20
33.5	34	24
104.5	116.5	95.5

Total, 316.5 pounds.

No. 4 LINES—Continued.

Coil 140.
Length between hooks, 24″.

Yarns from the—		
First strand.	Second strand.	Third strand.
Pounds.	*Pounds.*	*Pounds.*
17.5	18	20
25	19.5	25.5
20.5	24.5	23
21.5	22.5	19
84.5	84.5	87.5

Total, 256.5 pounds.

TESTS OF INDIVIDUAL STRANDS.

No. 4 LINE.

Coil 125.
Length between hooks, 6″.

First strand.	Second strand.	Third strand.
Pounds.	*Pounds.*	*Pounds.*
110	108	112

Total, 330 pounds.

TENSILE TESTS OF CORDAGE FOR THE UNITED STATES LIGHT-HOUSE ESTABLISHMENT, THIRD DISTRICT, TOMPKINSVILLE, N. Y.

TARRED HEMP ROPE.

Samples prepared for testing with ends seized together. Tested over smooth, round pins, with leather cushions.

3-inch, 4-strand rope.

Number of sample.	Tensile strength.	Parted.
	Pounds.	
1	2,400	Pulled ends through seizing.
2	3,500	Do.
3	3,200	Do.

MANILA ROPE.

Samples prepared for testing with eye splices at the ends.

Description.	Tensile strength.	Parted.
	Pounds.	
9-thread manila	1,320	1 strand at the splice.
Do	1,180	Do.
18-thread manila	2,290	1 strand 15″ from the splice.
Do	2,280	1 strand 9″ from the splice.
5-inch, 4-strand	18,500	2 strands at the splice.
Do	19,400	1 strand at the splice.
6-inch, 4-strand	21,900	Do.
Do	24,100	Do.

MANILA ROPE.

Samples provided with eye splices at the ends.
6-inch, 4-strand rope.
Length between splices, 6 feet.

Number of sample.	Tensile strength.	Parted.
	Pounds.	
1	21,400	1 strand at the splice.
2	22,800	2 strands at the splice.

MANILA ROPE.

Samples provided with eye splices at the ends.
6-inch, 4-strand rope.
Length between splices, 6 feet.
Splices wet before testing.

Number of sample.	Tensile strength.	Parted.
	Pounds.	
1	25,100	2 strands at the splice.
2	22,600	Do.

MANILA AND HEMP ROPE.

Samples prepared for testing with eye splices at the ends.
Length between splices, from 4 to 5 feet.

Description.	Number of strands.	Tensile strength.	Parted.
		Pounds.	
12-thread manila	3	1,320	1 strand at the splice.
Do	3	1,290	2 strands at the splice.
15-thread manila	3	1,400	1 strand at the splice.
Do	3	1,480	Do.
18-thread manila	3	1,670	2 strands at the splice.
Do	3	1,690	1 strand at the splice.
1½-inch manila	3	2,180	2 strands at the splice.
Do	3	1,700	1 strand at the splice.
2-inch manila	4	3,890	Do.
Do	4	4,200	2 strands at the splice.
2½-inch manila	4	4,900	Do.
Do	4	4,980	Do.
3-inch manila	4	6,100	1 strand at the splice.
Do	4	6,480	2 strands at the splice.
3½-inch manila	4	9,400	Do.
Do	4	9,820	1 strand at the splice.
4-inch manila	4	11,300	Do.
Do	4	11,900	Do.
4½-inch manila	4	13,180	Do.
Do	4	12,000	2 strands at the splice.
5-inch manila	4	18,700	1 strand at the splice.
Do	4	18,220	Do.
5½-inch manila	4	16,700	Do.
Do	4	17,980	Do.
6-inch manila	4	21,000	2 strands at the splice.
Do	4	22,600	Do.
3-inch hemp	4	5,300	1 strand at the splice.
Do	4	5,400	3 strands at the splice.

MANILA AND HEMP ROPE.

Samples prepared for testing with eye splices at the ends.
Length between splices, from 3′ to 5′.

Description.	Number of strands.	Tensile strength.	Parted.
		Pounds.	
15-thread manila	3	2,000	1 strand 15″ from the splice.
Do	3	1,980	1 strand at the splice.
18-thread manila	3	2,200	1 strand 16″ from the splice.
Do	3	2,400	1 strand 6″ from the splice.
21-thread manila	3	2,580	1 strand at the splice.
Do	3	2,500	Do.
3-inch manila	4	9,200	Do.
Do	4	9,400	2 strands at the splice.
4-inch manila	4	16,400	1 strand 3″ from the splice.
Do	4	15,400	1 strand at the splice.
4½-inch manila	4	20,100	2 strands in the eye.
Do	4	19,300	1 strand 3″ from the splice.
5-inch manila	4	20,900	1 strand in the eye.
Do	4	23,700	1 strand 3″ from the splice.
5½-inch manila	4	24,700	1 strand at the splice.
Do	4	24,800	Do.
6-inch manila	4	29,500	Do.
Do	4	31,600	2 strands at the splice.
7-inch manila	4	39,200	1 strand at the splice.
Do	4	32,000	2 strands at the splice.
2½-inch hemp	4	5,400	1 strand at the splice.
3-inch hemp	4	7,300	Do.
3½-inch hemp	4	8,800	Do.

MANILA AND HEMP ROPE.

Samples prepared for testing with eye splices at the ends.
Length between splices, about 4′ 3″.

Description.	Number of strands.	Tensile strength.	Parted.
		Pounds.	
3½-inch hemp	4	9,420	3 strands at the splice.
7-inch manila	4	25,400	1 strand at the splice.
7-inch manila	4	32,200	2 strands at the splice.

MANILA AND HEMP ROPE.

Samples prepared for testing with eye splices at the ends.
Samples from 4 to 6 feet long between eye splices.

Description.	Circumference.	Number of strands.	Tensile strength.	Parted.
	Inch.		*Pounds.*	
Hemp	4.0	4	9,520	1 strand at middle of length.
Do	4.125	4	9,200	2 strands at the splice.
Manila	7.8	4	41,200	Do.
Do	7.8	4	46,100	2 strands 14″ from splice.
Do	7.875	4	39,100	1 strand at the splice.
Do	7.875	4	35,700	Do.

TENSILE TESTS OF CORDAGE FOR THE ORDNANCE DEPARTMENT, U. S. ARMY.

TENSILE TESTS OF BRAIDED COTTON SASH CORD FOR USE ON FLOATING TARGETS.

Marks.	Diameter.	Tensile strength.	Parted.
		Pounds.	
1.....	.33	750	
2.....	.33	745	
6.....	.20	246	At the hitch.
7.....	.22	261	Do.
8.....	.26	396	Do.
.....	.24	252	22″ from hitch.

RAILROAD MATERIAL.

RAILROAD MATERIAL FURNISHED BY MR. P. H. DUDLEY.

Specimens marked 82 and 83 represent the metal in two splice bars, 20 inches long each, 4 bolt holes, from the Boston and Albany Railroad, and made by the Lackawanna Iron and Steel Company.

No. 84 represents a nickel-steel splice bar, 36″ long, 6 bolt holes, for 5½″ 80-pound rail, of the New York Central and Hudson River Railroad, Carnegie steel, 1903.

No. 86 came from a 36″ splice bar, 6 holes, from the New York Central and Hudson River Railroad, and made by the Pennsylvania Steel Company, 1903.

No. 65 is a specimen taken from the head of a new 85-pound section of a nickel-steel rail made by the Carnegie Steel Company, 1903. Heat No. 11112.

No. 67 is a specimen taken from the head of a new 5½″ 80-pound rail, nickel steel, made by the Carnegie Steel Company, 1903. Heat 15155. It represents some rails laid on the West Albany Hill, New York Central and Hudson River Railroad.

No. 8126.

Splice bar.
Marks, 82.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....	
30,000	.0029	0.	
35,000	.0034	.....	
40,000	.0039	0.	
41,000	.....	.....	Elastic limit. Load fell.
37,000	.0082	.....	
38,000	.0135	.....	
39,000	.0440	.....	
40,000	.0695	.....	
42,000	.0885	.....	
44,000	.1080	.....	
46,000	.11	.....	
48,000	.14	.....	
50,000	.17	.....	
52,000	.21	.....	
54,000	.26	.....	
56,000	.34	.....	
58,000	.53	.....	
58,480	.....	.....	Tensile strength.
0	1.05	.....	= 35 per cent.

Elongation of inch sections, ″.24, ″.56*, ″.25.
Diameter at fracture, ″.35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Appearance of fracture, fine silky.

No. 8127.

Splice bar.
Marks, 83.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
30,000	.0029	.....	
35,000	.0034	.....	
38,400	.....	.....	Elastic limit. Load fell.
36,000	.0100	.....	
37,000	.0125	.....	
38,000	.0402	.....	
39,000	.0515	.....	
40,000	.0580	.....	
42,000	.0740	.....	
44,000	.0897	.....	
46,000	.1075	.....	
48,000	.12	.....	
50,000	.15	.....	
52,000	.18	.....	
54,000	.22	.....	
56,000	.27	.....	
58,000	.33	.....	
60,000	.45	.....	
60,800	.....	.....	Tensile strength.
0	.99	.....	= 33 per cent.

Elongation of inch sections, ".45*, ".31, ".23.
Diameter at fracture, ".35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Appearance of fracture, fine silky.

No. 8128.

Splice bar, nickel steel.
Marks, 84.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0039	0.	
50,000	.0050	0.	
53,000	.0054	.....	Elastic limit.
54,000	.0057	.....	Load fell.
50,000	.0123	.....	
51,000	.0160	.....	
52,000	.0585	.....	
53,000	.0644	.....	
54,000	.0714	.....	
56,000	.0840	.....	
58,000	.1085	.....	
60,000	.12	.....	
62,000	.14	.....	
64,000	.17	.....	
66,000	.20	.....	
68,000	.25	.....	
70,000	.35	.....	
72,000	.49	.....	
72,400	.....	.....	Tensile strength.
0	.90	.....	= 30 per cent.

Elongation of inch sections, ".21, ".50*, ".19.
Diameter at fracture, ".36; area, .1018 square inch.
Contraction of area, 59.3 per cent.
Appearance of fracture, fine silky.

No. 8129.

Splice bar.
Marks, 86.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0040	0.	
45,000	.0045	.....	
46,000	.0047	.....	Elastic limit.
47,000	.0080	.....	Load fell.
43,000	.0094	.....	
44,000	.0134	.....	
45,000	.0485	.....	
46,000	.0540	.....	
48,000	.0657	.....	
50,000	.0803	.....	
52,000	.0962	.....	
54,000	.11	.....	
56,000	.13	.....	
58,000	.16	.....	
60,000	.19	.....	
62,000	.23	.....	
64,000	.28	.....	
66,000	.35	.....	
68,000	.49	.....	
68,400	.....	.....	Tensile strength.
0	.90	.....	=30 per cent.

Elongation of inch sections, ".30, ".41*, ".19.
Diameter at fracture, ".37; area, .1075 square inch.
Contraction of area, 57 per cent.
Appearance of fracture, fine silky.

No. 8130.

Nickel-steel rail.
Marks, 65.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0040	.0002	
45,000	.0047	.0004	
46,000	.0051	.....	
47,000	.0054	.....	
48,000	.0056	.....	
49,000	.0058	.....	
50,000	.0060	.0008	
51,000	.0062	.....	
52,000	.0064	.....	
53,000	.0066	.....	
54,000	.0069	.....	
55,000	.0071	.0015	
56,000	.0074	.....	
57,000	.0078	.....	
58,000	.0082	.....	
59,000	.0086	.....	
60,000	.0090	.0028	
62,000	.0100	.....	
64,000	.0111	.....	
66,000	.0131	.....	
68,000	.0157	.....	
70,000	.0177	.0099	
72,000	.0213	.....	
74,000	.0240	.....	
76,000	.0274	.....	
78,000	.0314	.....	
80,000	.0354	.0259	
90,000	.06	.....	
100,000	.09	.....	
110,000	.14	.....	
120,000	.33	.....	
120,400	.....	.....	Tensile strength.
0	.46	.....	=15.3 per cent.

Elongation of inch sections, ".15*, ".21*, ".10.
Diameter at fracture, ".49; area, .1886 square inch.
Contraction of area, 24.6 per cent.
Appearance of fracture, fine granular.

No. 8131.

Nickel-steel rail.
Marks, 67.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
30,000	.0080	.....	
40,000	.0041	.0001	
45,000	.0049	.0004	
50,000	.0061	.0009	
55,000	.0074	.0016	
60,000	.0096	.0081	
65,000	.0122	.....	
70,000	.0162	.0083	
75,000	.0213	.....	
80,000	.0299	.0205	
90,000	.04	.....	
100,000	.08	.....	
110,000	.12	.....	
120,000	.20	.....	
124,000	.....	.....	Tensile strength.
0	.42	.....	= 14 per cent.

Elongation of inch sections, ″.10, ″.20*, ″.12.
Diameter at fracture, ″.49; area, .1886 square inch.
Contraction of area, 24.6 per cent.
Appearance of fracture, fine granular.

ENDURANCE OF ROTATING SHAFTS.

NO. 375.

ECCENTRIC FRACTURE OF ENDURANCE SHAFT, AT FINE LINE ON SURFACE, 2.7 FROM EDGE OF MIDDLE BEARING.

No. 375.

Marks, .17C.
Gautier steel bar; 0.17 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
30,000	.....	65,660,780	.....	.....	.....	.....	.....	.....	Reported in 1904.
30,000	19,100,220	84,761,000	a	.1555	.1308	.1547	.0244	.0008	
	.....	.....	b	.1558	.1305	.1551	.0246	.0007	
30,000	15,239,000	100,000,000	a	.1560	.1305	.1554	.0249	.0006	
	.....	.....	b	.1563	.1310	.1557	.0247	.0006	
35,000	0	100,000,000	a	.1562	.1258	.1554	.0296	.0008	
	.....	.....	b	.1563	.1260	.1554	.0294	.0009	
35,000	100	100,000,100	a	.1549	.1258	.1546	.0288	.0008	
	.....	.....	b	.1570	.1268	.1554	.0286	.0016	
35,000	1,000	100,001,100	a	.1554	.1262	.1548	.0286	.0006	
	.....	.....	b	.1570	.1265	.1552	.0287	.0018	
35,000	10,000	100,011,100	a	.1545	.1254	.1543	.0289	.0002	
	.....	.....	b	.1574	.1264	.1552	.0288	.0022	
35,000	100,000	100,111,100	a	.1541	.1252	.1539	.0287	.0002	
	.....	.....	b	.1570	.1258	.1547	.0289	.0023	
35,000	3,442,850	103,553,950	a	.1588	.1250	.1587	.0287	.0001	
	.....	.....	b	.1580	.1273	.1558	.0285	.0022	
35,000	2,916,510	106,470,460	.....	.....	.....	.....	.....	.....	Bar ruptured. Eccentric fracture, occurring 2″.7 beyond the edge of the south middle bearing, at a fine line scratched on the surface of the bar which was used for locating the position of the micrometer beam.

No. 383.

Marks, .55C.
Gautier steel bar, 0.55 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
30,000	.....	60,846,970	.....	.....	.....	.....	.....	.....	Reported in 1904.
30,000	14,159,030	75,006,000	a	.1543	.1295	.1542	.0247	.0091	
.....	.....	.....	b	.1545	.1298	.1542	.0244	.0008	
60,000	0	75,006,000	a	.1595	.1039	.1525	.0486	.0070	
.....	.....	.....	b	.1562	.1034	.1523	.0489	.0039	
60,000	100	75,006,100	a	.1513	.0880	.1394	.0514	.0119	
.....	.....	.....	b	.1580	.0882	.1411	.0529	.0169	
30,000	0	75,006,100	a	.1613	.1334	.1585	.0251	.0028	
.....	.....	.....	b	.1604	.1225	.1475	.0250	.0029	
30,000	220,490	75,226,590	a	.1569	.1300	.1548	.0248	.0011	
.....	.....	.....	b	.1540	.1278	.1527	.0249	.0013	
60,000	0	75,226,590	a	.1569	.0927	.1440	.0513	.0120	
.....	.....	.....	b	.1637	.0915	.1434	.0519	.0208	
60,000	1,000	75,227,590	.....	.....	.....	.....	.....	.....	
30,000	0	75,227,590	a	.1301	.1037	.1283	.0246	.0018	
.....	.....	.....	b	.1897	.1647	.1896	.0248	.0002	
30,000	158,740	75,386,330	.....	.....	.....	.....	.....	.....	Shaft wabbles under reduced load, after having been loaded with 60,000 pounds per square inch.
60,000	0	75,386,330	.....	.....	.....	.....	.....	.....	
60,000	1,000	75,387,330	.....	.....	.....	.....	.....	.....	
30,000	0	75,387,330	.....	.....	.....	.....	.....	.....	
30,000	148,030	75,535,360	.....	.....	.....	.....	.....	.....	
60,000	0	75,535,360	.....	.....	.....	.....	.....	.....	
60,000	1,000	75,536,360	.....	.....	.....	.....	.....	.....	
30,000	0	75,536,360	.....	.....	.....	.....	.....	.....	
30,000	161,500	75,697,860	.....	.....	.....	.....	.....	.....	
60,000	0	75,697,860	.....	.....	.....	.....	.....	.....	
60,000	1,000	75,698,860	.....	.....	.....	.....	.....	.....	
30,000	0	75,698,860	.....	.....	.....	.....	.....	.....	
30,000	169,220	75,868,080	a	.1375	.1112	.1360	.0248	.0015	
.....	.....	.....	b	.1728	.1463	.1711	.0248	.0017	
60,000	0	75,868,080	a	.1370	.0725	.1230	.0505	.0140	
.....	.....	.....	b	.1822	.1120	.1635	.0515	.0187	
60,000	1,000	75,869,080	a	.1310	.0751	.1255	.0504	.0055	
.....	.....	.....	b	.1822	.1030	.1548	.0518	.0274	
30,000	0	75,869,080	.....	.....	.....	.....	.....	.....	
30,000	177,290	76,046,370	.....	.....	.....	.....	.....	.....	
60,000	0	76,046,370	.....	.....	.....	.....	.....	.....	
60,000	1,000	76,047,370	.....	.....	.....	.....	.....	.....	
30,000	0	76,047,370	.....	.....	.....	.....	.....	.....	
30,000	138,700	76,186,070	.....	.....	.....	.....	.....	.....	
60,000	0	76,186,070	.....	.....	.....	.....	.....	.....	
60,000	1,000	76,187,070	.....	.....	.....	.....	.....	.....	
30,090	0	76,187,070	.....	.....	.....	.....	.....	.....	
30,000	142,990	76,330,060	a	.1580	.1287	.1527	.0240	.0003	
.....	.....	.....	b	.1555	.1305	.1553	.0248	.0002	
60,000	0	76,330,060	a	.1580	.1037	.1518	.0481	.0012	
.....	.....	.....	b	.1566	.1050	.1543	.0493	.0023	

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
60,000	1,000	76,331,060	a	.1636	.0855	.1448	.0593	.0188	
			b	.1618	.0755	.1333	.0578	.0285	
30,000	0	76,331,060	a	.1722	.1337	.1618	.0281	.0104	
			b	.1464	.1145	.1425	.0280	.0039	
30,000	3,280	76,334,340							Bar ruptured between bearings, 1″ from edge of south middle bearing.

No. 385.

Marks, .82C.
Gautier steel; 0.82 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on cord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
35,000		61,200,150							Reported in 1904.
35,000	876,510	62,076,660	a	.1554	.1278	.1558	.0275	.0001	
			b	.1555	.1277	.1255	.0278	0.	

After the shaft had made 62,076,660 rotations with a load of 35,000 pounds per square inch it was subjected to stresses of 55,000 and 35,000 pounds in alternate periods. A few rotations, comparatively, were made each day under the higher stress, the balance of the day's run being under 35,000 pounds.

Under the higher fiber stress 100 rotations were made each day for 120 days, followed by 1,000 rotations per day for 38 days and 10,000 rotations per day for 9 days. On the last day 830 rotations were made, when the rupture of the bar occurred. The total number of rotations under 55,000 pounds was 140,830.

Between each of these periods the shaft made from 188,000 to 192,000 rotations under 35,000 pounds per square inch.

A number of groups of micrometer readings are given below, sufficient to illustrate the behavior of the shaft during the progress of the test.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
55,000	.....	62,076,660	a	.1554	.1110	.1552	.0442	.0002	First application of 55,000 pounds per square inch.
	.....	.....	b	.1557	.1109	.1553	.0444	.0004	
55,000	.....	62,076,760	a	.1565	.1100	.1547	.0447	.0018	
	.....	.....	b	.1562	.1102	.1547	.0445	.0015	
35,000	.....	62,076,760	a	.1568	.1268	.1554	.0286	.0009	
	.....	.....	b	.1555	.1268	.1554	.0286	.0001	
35,000	.....	62,264,740	a	.1555	.1268	.1554	.0286	.0001	
	.....	.....	b	.1555	.1273	.1552	.0279	.0008	
35,000	.....	70,194,140	a	.1551	.1263	.1550	.0287	.0001	
	.....	.....	b	.1558	.1262	.1548	.0286	.0010	
55,000	.....	70,194,140	a	.1561	.1084	.1536	.0452	.0025	
	.....	.....	b	.1573	.1084	.1532	.0448	.0041	
55,000	.....	70,194,240	a	.1576	.1081	.1533	.0452	.0043	
	.....	.....	b	.1676	.1073	.1529	.0456	.0047	
35,000	.....	70,194,240	a	.1579	.1262	.1552	.0290	.0027	
	.....	.....	b	.1556	.1256	.1542	.0286	.0014	
35,000	.....	70,396,980	a	.1558	.1263	.1550	.0287	.0008	
	.....	.....	b	.1558	.1262	.1547	.0285	.0011	
35,000	.....	80,097,670	a	.1558	.1260	.1548	.0288	.0010	
	.....	.....	b	.1557	.1260	.1546	.0286	.0011	
55,000	.....	80,097,670	a	.1559	.1079	.1533	.0454	.0026	
	.....	.....	b	.1573	.1079	.1532	.0453	.0041	
55,000	.....	80,097,770	a	.1583	.1075	.1530	.0455	.0053	
	.....	.....	b	.1573	.1070	.1527	.0457	.0046	
35,000	.....	80,097,770	a	.1577	.1260	.1550	.0290	.0027	
	.....	.....	b	.1555	.1258	.1540	.0287	.0015	
35,000	.....	90,361,080	a	.1553	.1266	.1552	.0286	.0001	
	.....	.....	b	.1561	.1261	.1548	.0287	.0013	
55,000	.....	90,361,080	a	.1566	.1067	.1537	.0450	.0029	
	.....	.....	b	.1578	.1083	.1538	.0450	.0045	
55,000	.....	90,392,080	a	.1520	.1060	.1515	.0455	.0005	
	.....	.....	b	.1596	.1069	.1529	.0460	.0067	
35,000	.....	90,392,080	a	.1583	.1264	.1550	.0286	.0033	
	.....	.....	b	.1563	.1255	.1545	.0290	.0018	
35,000	.....	93,573,120	a	.1570	.1266	.1558	.0292	.0012	
	.....	.....	b	.1557	.1256	.1544	.0288	.0013	
55,000	.....	93,573,120	a	.1569	.1086	.1540	.0454	.0029	
	.....	.....	b	.1568	.1072	.1528	.0456	.0040	
55,000	.....	93,583,120	a	.1595	.1097	.1548	.0451	.0047	
	.....	.....	b	.1560	.1057	.1513	.0456	.0047	
35,000	.....	93,583,120	a	.1597	.1276	.1566	.0290	.0031	
	.....	.....	b	.1545	.1240	.1530	.0290	.0015	
									Rest of 16 days without load.
35,000	.....	93,738,900	a	.1564	.1276	.1563	.0287	.0001	
	.....	.....	b	.1552	.1250	.1540	.0290	.0012	
55,000	.....	93,738,900	a	.1575	.1099	.1547	.0448	.0028	
	.....	.....	b	.1567	.1067	.1525	.0458	.0042	
55,000	.....	93,739,780	.....	.....	.....	.....	.....	.....	Total for both loads. Bar ruptured between bearings, .90 from edge of north middle bearings.

No. 388.

Marks, .82C.
Gautier steel; 0.82 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	.....	58,140,720	.....	.....	.....	.....	.....	.....	Reported in 1904.
40,000	36,898,170	95,038,890	a	.1561	.1235	.1561	.0326	0.	
	.....	.....	b	.1563	.1235	.1560	.0325	.0008	
40,000	8,169,500	103,208,390	.....	.....	.....	.....	.....	.....	Bar not ruptured. Still running.

No. 389.

Marks, .34C.
Gautier steel; 0.34 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
60,000	0	0	a	.1557	.1078	.1554	.0476	.0008	
	.....	.....	b	.1558	.1075	.1554	.0479	.0004	
60,000	100	100	a	.1574	.0990	.1478	.0488	.0096	
	.....	.....	b	.1626	.0985	.1475	.0490	.0151	
60,000	900	1,000	a	.1934	.1250	.1737	.0487	.0197	
	.....	.....	b	.1325	.0615	.1108	.0488	.0222	
60,000	13,630	14,630	.....	.....	.....	.....	.....	.....	Bar ruptured, between middle bearings, 1″ from edge of south middle bearing.

The bar run hot. A stream of water was played on it during the test, after the first 1,000 rotations.

No. 390.

Marks, .34C.
Gautier steel bar; 0.34 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
50,000	0	0	a	.1558	.1155	.1550	.0395	.0003	
			b	.1556	.1152	.1552	.0400	.0004	
50,000	100	100	a	.1560	.1140	.1542	.0402	.0018	
			b	.1563	.1142	.1545	.0403	.0018	
50,000	900	1,000	a	.1587	.1092	.1502	.0410	.0085	
			b	.1600	.1098	.1508	.0410	.0092	
50,000	69,350	70,350							Bar ruptured between bearings, ″.9 from edge of north middle bearing.

Bar run hot. A stream of water was played on it during the test after the first 1,000 rotations.

No. 391.

Marks, .73C.
Gautier steel bar; 0.73 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
60,000	0	0	a	.1569	.1087	.1567	.0480	.0002	
			b	.1572	.1078	.1568	.0490	.0004	
60,000	100	100	a	.1576	.1080	.1560	.0480	.0016	
			b	.1577	.1070	.1560	.0490	.0017	
60,000	900	1,000	a	.1603	.1044	.1542	.0498	.0061	
			b	.1595	.1030	.1535	.0505	.0060	
60,000	54,390	55,390							Bar ruptured, between bearings, 1″ from edge of north middle bearing.

The bar run hot. A stream of water was played on it during the test, after the first 1,000 rotations.

No. 392.

Marks, .73C.
Gautier steel bar; 0.73 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
50,000	0	0	a	.1553	.1145	.1552	.0407	.0001	
			b	.1554	.1142	.1552	.0410	.0002	
50,000	100	100	a	.1551	.1144	.1552	.0408	−.0001	
			b	.1553	.1145	.1552	.0407	.0001	
50,000	900	1,000	a	.1554	.1143	.1549	.0406	.0005	
			b	.1545	.1138	.1548	.0410	.0007	
50,000	238,212	239,212							Bar ruptured, between bearings 1″.1 from edge of north middle bearing.

Bar run hot. A stream of water was played on it during the test, after the first 1,000 rotations.

No. 393.

Marks, 1.09C.
Gautier steel bar; 1.09 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
60,000	0	0	a	.1560	.1075	.1557	.0482	.0003	
			b	.1563	.1076	.1555	.0479	.0008	
60,000	100	100	a	.1577	.1055	.1548	.0493	.0029	
			b	.1572	.1060	.1548	.0488	.0024	
60,000	900	1,000	a	.1350	.0810	.1333	.0523	.0017	
			b	.1751	.1198	.1715	.0517	.0036	
60,000	16,540	17,540							Bar ruptured, between bearings, ″.8 from edge of north middle bearing.

The bar run hot. A stream of water was played on it during the test after the first 1,100 rotations.

No. 394.

Marks, 1.09C.
Gautier steel bar; 1.09 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
50,000	0	0	a	.1547	.1155	.1552	.0397	—.0005	
			b	.1556	.1145	.1552	.0407	.0004	
50,000	100	100	a	.1554	.1148	.1551	.0403	.0003	
			b	.1556	.1142	.1554	.0412	.0002	
50,000	900	1,000	a	.1552	.1113	.1527	.0414	.0025	
			b	.1578	.1115	.1536	.0421	.0042	
50,000	60,080	61,080							Bar ruptured, under the south middle bearing.

The bar run hot. A stream of water was played on it during the test, after the first 1,100 rotations.

No. 395.

Marks. .34C.
Gautier steel bar, 0.34 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1569	.1197	.1567	.0370	.0002	
			b	.1569	.1208	.1565	.0357	.0004	
45,000	100	100	a	.1570	.1200	.1565	.0365	.0005	
			b	.1568	.1208	.1565	.0357	.0008	
45,000	900	1,000	a	.1580	.1140	.1558	.0418	.0022	
			b	.1574	.1197	.1557	.0360	.0017	
45,000	9,000	10,000	a	.1585	.1163	.1537	.0374	—.0002	
			b	.1592	.1185	.1556	.0371	.0036	
45,000	156,360	166,360							Bar ruptured between bearings, 1.″5 from edge of south middle bearing.

The bar run hot. A stream of water was played on it during the test, after the first 10,000 rotations.

No. 396.

Marks, .73C.
Gautier steel bar, 0.73 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1553	.1188	.1551	.0363	.0002	
			b	.1555	.1182	.1553	.0371	.0002	
45,000	100	100	a	.1552	.1192	.1552	.0360	0.	
			b	.1555	.1184	.1553	.0369	.0002	
45,000	900	1,000	a	.1554	.1185	.1553	.0368	.0001	
			b	.1555	.1186	.1553	.0367	.0002	
45,000	9,000	10,000	a	.1547	.1180	.1547	.0367	0.	
			b	.1559	.1182	.1551	.0369	.0008	
45,000	7,254,010	7,264,010							Bar ruptured. Eccentric fracture occurring 2″.75 beyond the edge of the north middle bearing, at a fine line scratched on the surface of the bar which was used for locating the position of the micrometer beam.

No. 397.

Marks, Rail No. 66.
From head of nickel steel railroad rail.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1562	.1228	.1561	.0333	.0001	
			b	.1552	.1221	.1550	.0329	.0002	
40,000	100	100	a	.1563	.1230	.1565	.0335	—.0002	
			b	.1550	.1220	.1549	.0329	.0001	
40,000	900	1,000	a	.1565	.1230	.1565	.0335	0.	
			b	.1548	.1215	.1543	.0328	.0005	
40,000	445,970	446,970							Bar ruptured. Eccentric fracture, occurring 2″.25 beyond the edge of the south middle bearing, at a place where the emery wheel, used in grinding the bar, chanced to leave a slightly flattened spot.

No. 398.

Marks, .17C1.

Gautier steel; 0.17 per cent carbon; 1¼″ hot-rolled bar, annealed and endurance shaft turned down therefrom.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1565	.1241	.1562	.0321	.0003	
			b	.1563	.1232	.1548	.0316	.0015	
40,000	100	100	a	.1592	.1236	.1558	.0322	.0034	
			b	.1565	.1224	.1533	.0309	.0032	
40,000	900	1,000	a	.1550	.1173	.1555	.0382	−.0005	
			b	.1611	.1126	.1460	.0334	.0151	
40,000	127,260	128,260							Bar ruptured, between bearings, 1″ from edge of south middle bearing.

The bar run hot. A stream of water was played on it during the test after the first 1,000 rotations.

No. 399.

Marks, .17C2.
Gautier steel; 0.17 per cent carbon.
1¼″ hot rolled bar, heated to first red and quenched in oil.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on a chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1575	.1258	.1573	.0315	.0002	
			b	.1564	.1243	.1562	.0319	.0002	
40,000	100	100	a	.1575	.1252	.1573	.0321	.0002	
			b	.1564	.1242	.1562	.0320	.0002	
40,000	900	1,000	a	.1573	.1246	.1571	.0325	.0002	
			b	.1565	.1240	.1561	.0321	.0004	
40,000	463,450	464,450							Bar ruptured between bearings, 1″.5 from edge of south middle bearing.

The bar run hot. A stream of water was played on it during the test, after the first 1,000 rotations.

No. 400.

Marks, .17C3.
Gautier steel; 0.17 per cent carbon.
1¼″ hot-rolled bar, heated to a low yellow and quenched in oil.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1570	.1250	.1569	.0319	.0001	
	.....	.....	b	.1578	.1252	.1575	.0323	.0003	
40,000	100	100	a	.1570	.1245	.1568	.0323	.0002	
	.....	.....	b	.1579	.1249	.1574	.0325	.0005	
40,000	900	1,000	a	.1577	.1242	.1565	.0323	.0012	
	.....	.....	b	.1580	.1240	.1568	.0328	.0012	
40,000	208,520	209,520	.....	.....	.....	.....	.....	.....	Bar ruptured between bearings, 1″.25 from edge of north middle bearing.

The bar run hot. A stream of water was played on it during the test, after the first 1,000 rotations.

No. 401.

Marks, 17C4.
Gautier steel; 0.17 per cent carbon.
1¼″ hot rolled bar, heated to a low yellow and quenched in water.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1552	.1213	.1520	.0307	.0032	
	.....	.....	b	.1592	.1237	.1557	.0320	.0035	
40,000	100	100	a	.1553	.1233	.1547	.0314	.0006	
	.....	.....	b	.1563	.1233	.1555	.0322	.0008	
40,000	900	1,000	a	.1555	.1220	.1548	.0328	.0007	
	.....	.....	b	.1562	.1225	.1555	.0330	.0007	
40,000	446,810	447,810	.....	.....	.....	.....	.....	.....	Bar ruptured between bearings, 1″ from edge of north middle bearing.

The bar run hot. A stream of water was played on it, during the test, after the first 1,000 rotations.

No. 402.

Marks, .17C5.

Gautier steel; 0.17 per cent carbon.

1¼″ hot rolled bar, heated to a low yellow, quenched in water, reheated to a full yellow, and cooled in sand.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1548	.1224	.1547	.0323	.0001	
			b	.1557	.1282	.1555	.0323	.0002	
40,000	100	100	a	.1550	.1224	.1546	.0322	.0004	
			b	.1557	.1237	.1553	.0316	.0004	
40,000	900	1,000	a	.1550	.1215	.1542	.0327	.0008	
			b	.1560	.1230	.1552	.0322	.0008	
40,000	116,730	117,730							Bar ruptured between bearings, ″.20 from edge of north middle bearing.

The bar run hot. A stream of water was played on it during the test, after the first 1,000 rotations.

No. 403.

Marks, 1.09C.
Gautier steel; 1.09 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1553	.1182	.1553	.0371	0.	
			b	.1557	.1189	.1556	.0367	.0001	
45,000	100	100	a	.1558	.1182	.1554	.0372	.0001	
			b	.1558	.1191	.1556	.0365	.0002	
45,000	900	1,000	a	.1554	.1180	.1550	.0370	.0004	
			b	.1560	.1182	.1553	.0371	.0007	
45,000	181,700	182,700							Bar ruptured, between bearings, ″.35 from edge of north middle bearing.

The bar run hot. A stream of water was played on it during the test, after 1,000 rotations.

No. 404.

Marks, 1.09C.
Gautier steel; 1.09 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on a chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1561	.1242	.1560	.0318	.0001	
			b	.1563	.1241	.1562	.0321	.0001	
40,000	100	100	a	.1562	.1238	.1561	.0323	.0001	
			b	.1562	.1242	.1562	.0320	0.	
40,000	900	1,000	a	.1560	.1243	.1559	.0316	.0001	
			b	.1562	.1243	.1562	.0319	0.	
40,000	482,380	483,380							Bar ruptured between bearings, ″.90 from edge of north middle bearing.

The bar run hot. A stream of water was played on it during the test, after the first 1,000 rotations.

No. 405.

Marks, 1.09C.
Gautier steel; 1.09 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
35,000	0	0	a	.1556	.1270	.1555	.0285	.0001	
			b	.1556	.1272	.1555	.0283	.0001	
35,000	100	100	a	.1556	.1270	.1555	.0285	.0001	
			b	.1555	.1275	.1555	.0280	0.	
35,000	900	1,000	a	.1556	.1270	.1555	.0285	.0001	
			b	.1555	.1273	.1555	.0282	0.	
35,000	5,503,730	5,504,730	a	.1558	.1270	.1558	.0288	0.	
			b	.1559	.1273	.1557	.0284	.0002	
35,000	7,371,700	12,876,430							Bar not ruptured. Still running.

ENDURANCE OF ROTATING SHAFTS.

SUMMARIZED TABULATION.

Speed of rotation, 500 per minute.

No. of test.	Marks.	Material.	Treatment.	Composition.				Maximum fiber stress per square inch.	Number of rotations.		Remarks.
				C.	Mn.	Si.	Ni.		Successive.	Total.	
								Pounds.			
375	.17C	Gautier steel.....	Hot rolled bar....	.17	.57	.04	.....	30,000	100,000,000	100,000,000	
								35,000	6,470,460	106,470,460	Bar ruptured. Eccentric fracture, 2″.7 outside middle bearings, at fine line scratched on surface of bar.
383	.55C	.....do.....	.....do.....	.55	.75	.14	.....	30,000	76,326,240	.....	Aggregate of several runs.
								60,000	8,100	.....	Do.
										76,334,340	Total for both loads. Bar ruptured between bearings.
385	.82C	.....do.....	.....do.....	.82	.36	.10	.....	35,000	93,598,900	.....	Aggregate of several runs.
								55,000	140,880	.....	Do.
										93,739,780	Total for both loads. Bar ruptured.
388	.82C	.....do.....	.....do.....	.82	.36	.10	.....	40,000	.....	103,203,390	Bar not ruptured.
389	.34C	.....do.....	.....do.....	.34	.65	.34	.....	60,000	.....	14,630	Bar ruptured between bearings.
390	.34C	.....do.....	.....do.....	.34	.65	.34	.....	50,000	.....	70,350	Do.
391	.73C	.....do.....	.....do.....	.73	.64	.04	.....	60,000	.....	55,390	Do.
392	.73C	.....do.....	.....do.....	.73	.64	.04	.....	50,000	.....	239,212	Do.
393	1.09C	.....do.....	.....do.....	1.09	.39	.11	.....	60,000	.....	16,540	Do.
394	1.09C	.....do.....	.....do.....	1.09	.39	.11	.....	50,000	.....	61,030	Bar ruptured under south middle bearing.
395	.34C	.....do.....	.....do.....	.34	.65	.34	.....	45,000	.....	166,360	Bar ruptured between bearings.
396	.73C	.....do.....	.....do.....	.73	.64	.04	.....	45,000	.....	7,264,010	Bar ruptured. Eccentric fracture at fine line scratched on surface.
397	66	Steel rail	.....	.56	.80	.05	.....	40,000	.....	446,970	Bar ruptured. Eccentric fracture where emery wheel left slightly flattened spot.
398	.17C1	Gautier steel.....	Annealed	.17	.57	.04	.....	40,000	.....	128,260	Bar ruptured between bearings.
399	.17C2	.....do.....	Quenched in oil from first red.	.17	.57	.04	.....	40,000	.....	464,450	Do.
400	.17C3	.....do.....	Quenched in oil, low yellow heat.	.17	.57	.04	.....	40,000	.....	209,520	Do.
401	.17C4	.....do.....	Quenched in water, low yellow heat.	.17	.57	.04	.....	40,000	.....	447,810	Do.
402	.17C5	.....do.....	Quenched in water and annealed.	.17	.57	.04	.....	40,000	.....	117,730	Do.
403	1.09C	.....do.....	Hot rolled bar....	1.09	.39	.11	.....	45,000	.....	182,700	Do.
404	1.09C	.....do.....	.....do.....	1.09	.39	.11	.....	40,000	.....	433,880	Do.
405	1.09C	.....do.....	.....do.....	1.09	.39	.11	.....	35,000	.....	12,876,430	Bar not ruptured.

TENSILE SPECIMENS FROM RUPTURED ENDURANCE SHAFTS.

Tensile Specimens from Ruptured Endurance Shafts.

Specimens taken from the ends of ruptured bars. The tests are arranged in the order of the numbers of the endurance tests to which they refer.

No. 8109.

Marks, .55C.
Endurance test, No. 383.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
See Report of 1903, page 345, for Endurance test.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	0.	
40,000	.0039	.....	
45,000	.0044	.....	
50,000	.0050	0.	
55,000	.0055	.....	
58,000	.0058	.....	
59,000	.0060	.....	Elastic limit.
59,500	.....	.....	Load fell.
56,000	.0131	.....	
57,000	.0181	.....	
58,000	.0215	.....	
59,000	.0231	.....	
60,000	.0247	.0171	
62,000	.0279	.....	
64,000	.0311	.....	
66,000	.0348	.....	
70,000	.0438	.....	
75,000	.06	.....	
80,000	.07	.....	
85,000	.08	.....	
90,000	.10	.....	
95,000	.12	.....	
100,000	.15	.....	
105,000	.18	.....	
110,000	.32	.....	
111,200	.....	.....	Tensile strength.
0	.53	.....	=17.7 per cent.

Elongation of inch sections, ".15, ".26*, ".12.
Diameter at fracture, ".46; area, .1662 square inch.
Contraction of area, 33.5 per cent.
Appearance of fracture, silky, fine granular at circumference.

No. 8110.

Marks, .34C.
Endurance test, No. 389.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
30,000	.0030	0.	
40,000	.0040	0.	
45,000	.0044	.....	
50,000	.0049	0.	
52,000	.0051	.....	
54,000	.0053	.....	
55,000	.0054	.....	
56,000	.0055	.....	
56,400	.....	.....	Elastic limit. Load fell.
50,000	.0126	.....	
51,000	.0210	.....	
52,000	.0512	.....	
54,000	.0539	.....	
56,000	.0610	.....	
58,000	.0669	.....	
60,000	.0775	.....	
65,000	.10	.....	
70,000	.14	.....	
75,000	.18	.....	
80,000	.27	.....	
85,000	.58	.....	Tensile strength.
0	.82	.....	= 27.3 per cent.

Elongation of inch sections, ".19, ".45*, ".18.
Diameter at fracture, ".38; area, .1134 square inch.
Contraction of area, 54.6 per cent.
Appearance of fracture, silky.

No. 8111.

Marks, .34C.
Endurance test, No. 390.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0039	.....	
50,000	.0049	0.	
54,000	.0052	.....	Elastic limit. Load fell.
50,000	.0093	.....	
51,000	.0250	.....	
52,000	.0500	.....	
53,000	.0510	.....	
54,000	.0519	.....	
56,000	.0583	.....	
60,000	.0772	.....	
65,000	.10	.....	
70,000	.14	.....	
75,000	.18	.....	
80,000	.25	.....	
84,400	.52	.....	Tensile strength.
0	.81	.....	=27 per cent.

Elongation of inch sections, ″.19, ″.45*, ″.17.
Diameter at fracture, ″.38; area, .1134 square inch.
Contraction of area, 54.6 per cent.
Appearance of fracture, silky.

No. 8112.

Marks, .73C.
Endurance test, No. 391.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....	
30,000	.0028	.....	
40,000	.0038	.....	
50,000	.0048	0.	
60,000	.0058	0.	
65,000	.0067	.....	Elastic limit.
66,000	.0069	.....	
67,000	.0072	.....	
68,000	.0082	.....	
69,000	.0087	.....	
70,000	.0100	.0024	
71,000	.0112	.....	
72,000	.0120	.....	
73,000	.0130	.....	
74,000	.0141	.....	
76,000	.0170	.....	
80,000	.0220	.....	
85,000	.0280	.....	
90,000	.0355	.....	
95,000	.0435	.....	
100,000	.0520	.....	
105,000	.06	.....	
110,000	.07	.....	
115,000	.09	.....	
120,000	.10	.....	
125,000	.11	.....	
130,000	.14	.....	
135,000	.17	.....	
140,000	.31	.....	Tensile strength.
0	.32	.....	=10.7 per cent.

Elongation of inch sections, ".09, ".14*, ".09.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Appearance of fracture, fine granular.

No. 8113.

Marks, .73C.
Endurance test, No. 392.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0040	.....	
50,000	.0050	0.	
60,000	.0060	0.	
63,000	.0063	.....	
64,000	.0065	.....	Elastic limit.
65,000	.0068	.....	
66,000	.0071	.....	
67,000	.0074	.....	
68,000	.0080	.....	
69,000	.0086	.....	
70,000	.0094	.0019	
72,000	.0116	.....	
76,000	.0162	.....	
80,000	.0210	.....	
85,000	.0270	.....	
90,000	.0345	.....	
95,000	.0417	.....	
100,000	.0504	.....	
105,000	.06	.....	
110,000	.07	.....	
115,000	.08	.....	
120,000	.10	.....	
130,000	.13	.....	
140,000	.23	.....	
141,200	.....	.....	Tensile strength.
0	.27	.....	9 per cent.

Elongation of inch sections, ".10*, ".10, ".07.
Diameter at fracture, ".53; area, .2206 square inch.
Contraction of area, 11.8 per cent.
Appearance of fracture, fine granular.

No. 8114.

Marks, 1.09C.
Endurance test, No. 393.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0039	.....	
50,000	.0049	.....	
60,000	.0059	0.	
70,000	.0070	0.	
75,000	.0075	.....	
76,000	.0076	0.	
77,000	.0078	.....	Elastic limit.
78,000	.....	.....	Load fell.
72,000	.0119	.....	
73,000	.0130	.....	
74,000	.0312	.....	
76,000	.0325	.....	
78,000	.0342	.....	
80,000	.0363	.....	
85,000	.0425	.....	
90,000	.0500	.....	
95,000	.0565	.....	
100,000	.0642	.....	
110,000	.08	.....	
120,000	.11	.....	
130,000	.17	.....	
134,800	.....	.....	Tensile strength.
0	.25	.....	=8.3 per cent.

Elongation of inch sections, ".08, ".08, ".09*.
Diameter at fracture, ".54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Appearance of fracture, fine granular.

No. 8115.

Marks, 1.09C.
Endurance test, No. 394.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0039	.....	
50,000	.0051	.....	
60,000	.0062	0.	
70,000	.0073	.0001	
75,000	.0078	.....	
77,000	.0080	.....	
78,000	.0082	.....	Elastic limit. Load fell.
72,000	.0131	.....	
73,000	.0284	.....	
74,000	.0309	.....	
76,000	.0320	.....	
78,000	.0343	.....	
80,000	.0368	.....	
85,000	.0439	.....	
90,000	.0505	.....	
95,000	.0573	.....	
100,000	.0660	.....	
110,000	.09	.....	
120,000	.12	.....	
130,000	.17	.....	
134,400	.....	.....	Tensile strength.
0	.25	.....	= 8.3 per cent.

Elongation of inch sections, ″.08, ″.09*, ″.08*.
Diameter at fracture, ″.54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Appearance of fracture, fine granular.

No. 8116.

Marks, .34C.
Endurance test, No. 395.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0039	.....	
50,000	.0049	0.	
51,000	.0050	.....	
52,000	.0052	.....	
53,000	.0053	.....	
54,000	.0055	.....	
55,000	.0056	.....	Elastic limit. Load fell.
51,000	.0090	.....	
52,000	.0485	.....	
53,000	.0493	.....	
54,000	.0516	.....	
56,000	.0580	.....	
58,000	.0670	.....	
60,000	.0748	.....	
65,000	.10	.....	
70,000	.13	.....	
75,000	.18	.....	
80,000	.27	.....	
85,000	.51	.....	Tensile strength.
0	.83	.....	=27.7 per cent.

Elongation of inch sections, ".19, ".46*, ".18.
Diameter at fracture, ".38; area, .1134 square inch.
Contraction of area, 54.6 per cent.
Appearance of fracture, silky.

No. 8117.

Marks, .73C.
Endurance test, No. 396.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
30,000	.0030	.....	
40,000	.0043	.....	
50,000	.0058	.0001	
60,000	.0063	.0001	
63,000	.0067	.....	Elastic limit.
64,000	.0070	.....	
65,000	.0074	.....	
66,000	.0084	.....	
67,000	.0090	.....	
68,000	.0102	.....	
70,000	.0122	.0042	
72,000	.0144	.....	
74,000	.0162	.....	
76,000	.0190	.....	
80,000	.0246	.....	
85,000	.0310	.....	
90,000	.0384	.....	
95,000	.0464	.....	
100,000	.0555	.....	
105,000	.07	.....	
110,000	.08	.....	
120,000	.10	.....	
130,000	.14	.....	
135,000	.18	.....	
138,400	.....	.....	Tensile strength.
0	.34	.....	=11.3 per cent.

Elongation of inch sections, ".09, ".15*, ".10.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Appearance of fracture, granular.

No. 8118.

Marks, Rail 66.
Endurance test, No. 397.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	0.	
35,000	.0034	.....	
40,000	.0040	0.	
45,000	.0045	0.	
50,000	.0050	0.	
55,000	.0056	0.	
60,000	.0062	.0001	
65,000	.0068	.0001	
70,000	.0073	.0001	
75,000	.0082	.0004	Elastic limit.
80,000	.0095	.0009	
81,000	.0100	.....	
82,000	.0104	.....	
83,000	.0110	.....	
84,000	.0125	.....	
85,000	.0265	.....	
86,000	.0305	.....	
88,000	.0433	.....	
90,000	.05	.....	
95,000	.07	.....	
100,000	.08	.....	
105,000	.10	.....	
110,000	.13	.....	
115,000	.16	.....	
115,200	.....	.....	Tensile strength.
0	.15	.....	= 5 per cent.

Elongation of inch sections, ″.05, ″.06*, ″.04.
Diameter at fracture, ″.55; area, .2376 square inch.
Contraction of area, 5 per cent.
Appearance of fracture, fine granular.

No. 8119.

Marks, .17C_1.
Endurance test, No. 398.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0089	0.	
45,000	.0044	.....	
46,000	.....	.....	Elastic limit. Load fell.
36,000	.0100	.....	
37,000	.0124	.....	
38,000	.0170	.....	
39,000	.0651	.....	
40,000	.0684	.....	
41,000	.0720	.....	
42,000	.0792	.....	
43,000	.0815	.....	
44,000	.0885	.....	
46,000	.1066	.....	
50,000	.14	.....	
55,000	.21	.....	
60,000	.33	.....	
63,040	.....	.....	Tensile strength.
0	1.08	.....	= 34.3 per cent.

Elongation of inch sections, ".22, ".56*, ".25.
Diameter at fracture, ".35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Appearance of fracture, fine silky.

NOTE.—The metal of the endurance shaft was annealed before it was turned up and tested.

No. 8120.

Marks, .17C_2.
Endurance test, No. 399.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
30,000	.0030	.....	
40,000	.0040	.0001	
45,000	.0046	.....	
48,000	.0049	.....	
49,000	.0052	.....	Elastic limit.
50,000	.....	.....	Load fell.
46,000	.0085	.....	
47,000	.0100	.....	
48,000	.0157	.....	
49,000	.0335	.....	
50,000	.0360	.....	
52,000	.0437	.....	
54,000	.0541	.....	
56,000	.0630	.....	
60,000	.0886	.....	
65,000	.13	.....	
70,000	.19	.....	
75,000	.32	.....	
75,800	.....	.....	Tensile strength.
0	.31	.....	=27 per cent.

Elongation of inch sections, ".48*, ".20, ".13.
Diameter at fracture, ".35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Appearance of fracture, fine silky.
NOTE.—The metal of the endurance shaft was heated to first red and quenched in oil.

No. 8121.

Marks, .17C_2.
Endurance test, No. 400.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
30,000	.0029	.....	
40,000	.0039	0.	
45,000	.0045	.....	
50,000	.0050	0.	
53,000	.0053	.....	
54,000	.0055	.....	Elastic limit.
55,000	.....	.....	Load fell.
48,000	.0094	.....	
49,000	.0110	.....	
50,000	.0252	.....	
51,000	.0684	.....	
52,000	.0691	.....	
54,000	.0785	.....	
56,000	.0920	.....	
60,000	.13	.....	
66,000	.18	.....	
70,000	.29	.....	
73,000	.....	.....	Tensile strength.
0	.95	.....	= 31.7 per cent.

Elongation of inch sections, ".50*, ".25, ".20.
Diameter at fracture, ".33; area, .0855 square inch.
Contraction of area, 65.8 per cent.
Appearance of fracture, fine silky.

NOTE.—The metal of the endurance shaft was heated to a low yellow color and quenched in oil.

No. 8122.

Marks, .17C_4.
Endurance test, No. 401.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....	
30,000	.0028	.....	
40,000	.0038	0.	
45,000	.0043	.....	
50,000	.0049	0.	
54,000	.0054	.....	
54,400	.....	.....	Elastic limit. Load fell.
52,000	.0079	.....	
53,000	.0090	.....	
54,000	.0410	.....	
55,000	.0416	.....	
56,000	.0443	.....	
57,000	.0474	.....	
58,000	.0586	.....	
60,000	.0650	.....	
65,000	.0948	.....	
70,000	.14	.....	
75,000	.21	.....	
78,000	.....	.....	Tensile strength.
0	.58	.....	=19.3 per cent.

Elongation of inch sections, ".07, ".11, ".40*.
Diameter at fracture, ".35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Appearance of fracture, fine silky.

NOTE.—The metal of the endurance shaft was heated to a low yellow color and quenched in water.

No. 8123.

Marks, .17C_5.
Endurance test, No. 402.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
30,000	.0029	.....	
40,000	.0040	0.	
45,000	.0045	0.	
50,000	.0050	0.	
51,000	.0051	.....	Elastic limit. Load fell.
46,000	.0061	.....	
47,000	.0090	.....	
48,000	.0819	.....	
49,000	.0720	.....	
50,000	.0786	.....	
51,000	.0775	.....	
52,000	.0844	.....	
54,000	.0994	.....	
56,000	.11	.....	
60,000	.15	.....	
65,000	.21	.....	
70,000	.42	.....	
70,800	.....	.....	Tensile strength.
0	.92	.....	= 30.7 per cent.

Elongation of inch sections, ".53*, ".22, ".17.
Diameter at fracture, ".31; area, .0755 square inch.
Contraction of area, 69.8 per cent.
Appearance of fracture, fine silky.

NOTE.—The metal of the endurance shaft was heated to a low yellow color, quenched in water, and then annealed at a full yellow heat.

No. 8124.

Marks, 1.09C.
Endurance test, No. 403.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
30,000	.0030	0.	
40,000	.0041	.....	
50,000	.0051	.....	
60,000	.0061	0.	
70,000	.0072	0.	
75,000	.0078	.0001	
78,000	.0082	.....	Elastic limit. Load fell.
73,000	.0130	.....	
74,000	.0803	.....	
75,000	.0810	.....	
76,000	.0816	.....	
78,000	.0889	.....	
80,000	.0860	.....	
85,000	.0420	.....	
90,000	.0495	.....	
95,000	.0552	.....	
100,000	.0586	.....	
110,000	.07	.....	
120,000	.09	.....	
130,000	.16	.....	
135,200	.....	.....	Tensile strength.
0	.19	.....	=6.8 per cent.

Elongation of inch sections, ".05, ".07, ".07*.
Diameter at fracture, ".54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Appearance of fracture, fine granular.

No. 8125.

Marks, 1.09C.
Endurance test, No. 404.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
30,000	.0030	.....	
40,000	.0040	.....	
50,000	.0051	.....	
60,000	.0062	0.	
70,000	.0072	0.	
75,000	.0078	0.	
77,000	.0080	.....	Elastic limit. Load fell.
71,000	.0130	.....	
72,000	.0137	.....	
73,000	.0174	.....	
74,000	.0310	.....	
76,000	.0328	.....	
78,000	.0341	.....	
80,000	.0368	.....	
85,000	.0430	.....	
90,000	.0498	.....	
95,000	.0570	.....	
100,000	.0650	.....	
110,000	.09	.....	
120,000	.11	.....	
130,000	.17	.....	
134,400	.....	.....	Tensile strength.
0	.22	.....	=7.3 per cent.

Elongation of inch sections, ".07, ".09*, ".06.
Diameter at fracture, ".54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Appearance of fracture, fine granular

TABULATION OF TENSION SPECIMENS FROM ENDS OF BARS RUPTURED BY ENDURANCE TESTS OF ROTATING SHAFTS.

STEMS 3" LONG: ".564 DIAMETER.

Tension test Nos.	Endurance test Nos.	Description.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
			Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" " "	
8109	388	.55 carbon steel, hot-rolled bar	59,000	111,200	17.7	33.5	.15, .26*, .12	Silky, fine granular at circumference.
8110	389	.34 carbon steel, hot-rolled bar	56,400	85,000	27.3	54.6	.19, .45*, .18	Silky.
8111	390	.....do	54,000	84,400	27.0	54.6	.19, .45*, .17	Do.
8112	391	.78 carbon steel, hot-rolled bar	65,000	140,000	10.7	15.0	.09, .14*, .09	Fine granular.
8113	392	.....do	64,000	141,200	9.0	11.8	.10*, .10, .07	Do.
8114	393	1.09 carbon steel, hot-rolled bar	77,000	134,800	8.3	8.4	.08, .08, .09*	Do.
8115	394	.....do	78,000	134,400	8.3	8.4	.08, .09*, .08*	Do.
8116	395	.34 carbon steel, hot-rolled bar	55,000	85,000	27.7	54.6	.19, .46*, .18	Silky.
8117	396	.78 carbon steel, hot-rolled bar	63,000	138,400	11.3	15.0	.09, .15*, .10	Granular.
8118	397	Nickel steel railroad rail No. 66	75,000	115,200	5.0	5.0	.05, .06*, .04	Fine granular.
8119	398	.17 carbon steel, annealed	46,000	63,040	34.3	61.5	.22, .56*, .25	Fine silky.
8120	399	.17 carbon steel, heated first red and quenched in oil	49,000	75,800	27.0	61.5	.48*, .20, .13	Do.
8121	400	.17 carbon steel, heated low yellow and quenched in oil	54,000	78,000	31.7	65.8	.50*, .25, .20	Do.
8122	401	.17 carbon steel, heated low yellow and quenched in water	54,400	78,000	19.3	61.5	.07, .11, .40*	Do.
8123	402	.17 carbon steel, annealed after heating and quenching in water	51,000	70,800	30.7	69.8	.58*, .22, .17	Do.
8124	403	1.09 carbon steel, hot-rolled bar	78,000	135,200	6.3	8.4	.05, .07, .07*	Fine granular.
8125	404	.....do	77,000	134,400	7.3	8.4	.07, .09*, .06	Do.

AUXILIARY TO ENDURANCE TESTS.

SPECIMENS TO SHOW MECHANICAL WORK NECESSARY TO PRODUCE RUPTURE.

No. 8132.

Marks, .34C.
Diameter, ".798.
Sectional area, .50 square inch.
Gauged length, 4".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
30,000	.0040	0.	
40,000	.0055	0.	
50,000	.0069	.....	
54,000	.0074	.....	
54,400	.0075	.....	Elastic limit. Load fell. Mechanical work at elastic limit, 51.7 inch-pounds=4.3 foot-pounds per cubic inch.
50,000	.0104	.....	
51,000	.0200	.....	
52,000	.0633	.....	
53,000	.0664	.....	
54,000	.0690	.....	
56,000	.0780	.....	
58,000	.0886	.....	
60,000	.0998	.....	
62,000	.1107	.....	
64,000	.1234	.....	
66,000	.1375	.....	
68,000	.15	.....	
70,000	.17	.....	
72,000	.19	.....	
74,000	.21	.....	
76,000	.24	.....	
78,000	.27	.....	
80,000	.31	.....	
82,000	.37	.....	
84,000	.47	.....	
84,500	.55	.....	
85,000	.64	.....	Tensile strength.
0	1.07	.....	=26.7 per cent. Mechanical work necessary to produce rupture, 11,914 inch-pounds=993 foot-pounds per cubic inch.

Elongation of inch sections, ".20, ".52*, ".21, ".14.
Diameter at fracture, ".54; area, .229 square inch.
Contraction of area, 54.2 per cent.
Appearance of fracture, fine silky.

No. 8133.

Marks, .34C.
Diameter, ".798.
Sectional area, .50 square inch.
Gauged length, 4".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
30,000	.0041	0.	
40,000	.0054	.....	
50,000	.0069	.0001	
54,000	.0074	.....	
54,200	.0075	.....	Elastic limit. Load fell.
			Mechanical work at elastic limit, 51.5 inch-pounds=4.3 foot-pounds per cubic inch.
50,000	.0121	.....	
51,000	.0400	.....	
52,000	.0672	.....	
53,000	.0687	.....	
54,000	.0709	.....	
56,000	.0806	.....	
58,000	.0914	.....	
60,000	.1028	.....	
62,000	.1159	.....	
64,000	.1286	.....	
66,000	.1444	.....	
68,000	.16	.....	
70,000	.18	.....	
72,000	.20	.....	
74,000	.22	.....	
76,000	.25	.....	
78,000	.29	.....	
80,000	.34	.....	
82,000	.40	.....	
84,000	.51	.....	
84,200	.64	.....	Tensile strength.
0	1.07	.....	=26.7 per cent.
			Mechanical work necessary to produce rupture, 11,800 inch-pounds=983 foot-pounds per cubic inch.

Elongation of inch sections, ".19, ".49*, ".28, ".16.
Diameter at fracture, ".54; area, .229 square inch.
Contraction of area, 54.2 per cent.
Appearance of fracture, fine silky.

No. 8134.

Marks, .73C.
Diameter, ".798.
Sectional area, .50 square inch.
Gauged length, 4".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
30,000	.0040	.....	
40,000	.0054	.....	
50,000	.0068	.....	
60,000	.0088	.0001	
64,000	.0092	.....	Elastic limit. Mechanical work at elastic limit, 74.4 inch-pounds=6.2 foot-pounds per cubic inch.
65,000	.0096	.....	
66,000	.0106	.....	
67,000	.0118	.....	
68,000	.0130	.....	
70,000	.0160	.....	
72,000	.0186	.....	
76,000	.0251	.....	
80,000	.0319	.....	
84,000	.0385	.....	
88,000	.0464	.....	
92,000	.0541	.....	
96,000	.0620	.....	
100,000	.07	.....	
108,000	.09	.....	
116,000	.11	.....	
126,000	.16	.....	
130,000	.18	.....	
134,000	.21	.....	
136,000	.25	.....	
138,000	.29	.....	
140,000	.39	.....	
140,200	.40	.....	Tensile strength.
0	.40	.....	=10 per cent. Mechanical work necessary to produce rupture, 12,042 inch-pounds=1,003 foot-pounds per cubic inch.

Elongation of inch sections, ".09, ".09, ".11*, ".11*.
Diameter at fracture, ".75; area, .442 square inch.
Contraction of area, 11.6 per cent.
Appearance of fracture, fine granular.

No. 8135.

Marks, .73C.
Diameter, ".798.
Sectional area, .50 square inch.
Gauged length, 4".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
30,000	.0039	.....	
40,000	.0053	.....	
50,000	.0067	.....	
60,000	.0081	0.	
64,000	.0088	.....	
65,000	.0091	.....	
66,000	.0095	.....	Elastic limit. Mechanical work at elastic limit, 79.2 inch-pounds=6.6 foot-pounds per cubic inch.
67,000	.0101	.....	
68,000	.0109	.....	
69,000	.0119	.....	
70,000	.0129	.....	
72,000	.0157	.....	
74,000	.0186	.....	
76,000	.0216	.....	
78,000	.0245	.....	
80,000	.0278	.....	
84,000	.0350	.....	
88,000	.0421	.....	
92,000	.0502	.....	
100,000	.07	.....	
108,000	.09	.....	
116,000	.11	.....	
124,000	.15	.....	
130,000	.17	.....	
134,000	.21	.....	
138,000	.25	.....	
140,000	.31	.....	
141,200	.39	.....	Tensile strength.
0	.46	.....	=11.5 per cent. Mechanical work necessary to produce rupture, 11,787 inch-pounds=982 foot-pounds per cubic inch.

Elongation of inch sections, ".09, ".10, ".15*, ".12.
Diameter at fracture, ".73; area, .419 square inch.
Contraction of area, 16.2 per cent.
Appearance of fracture, fine granular.

No. 8136.

Marks, 1.09C.
Diameter, ".798.
Sectional area, .50 square inch.
Gauged length, 4".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
30,000	.0039	.....	
40,000	.0054	.....	
50,000	.0068	.....	
60,000	.0082	0.	
70,000	.0096	.....	
75,000	.0104	.....	
75,400	.0105	.....	Elastic limit. Load fell. Mechanical work at elastic limit, 99.9 inch-pounds=8.3 foot-pounds per cubic inch.
71,000	.0150	.....	
72,000	.0225	.....	
74,000	.0436	.....	
76,000	.0450	.....	
78,000	.0477	.....	
80,000	.0511	.....	
84,000	.0560	.....	
88,000	.0648	.....	
92,000	.0782	.....	
100,000	.09	.....	
108,000	.11	.....	
116,000	.13	.....	
124,000	.19	.....	
128,000	.28	.....	
132,000	.80	.....	Tensile strength.
0	.27	.....	=6.7 per cent. Mechanical work necessary to produce rupture, 8,042 inch-pounds=670 foot-pounds per cubic inch.

Elongation of inch sections, ".05, ".07, ".08*, ".07*.
Diameter at fracture, ".76; area, .454 square inch.
Contraction of area, 9.2 per cent.
Appearance of fracture, fine granular.

No. 8137.

Marks, 1.09C.
Diameter, ".798.
Sectional area, .50 square inch.
Gauged length, 4".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
30,000	.0039	.....	
40,000	.0052	.....	
50,000	.0066	.....	
60,000	.0080	0.	
70,000	.0095	.....	
75,000	.0101	.....	
76,000	.0108	.....	
77,000	.0105	.....	Elastic limit. Load fell. Mechanical work at elastic limit, 102 inch-pounds=8.5 foot-pounds per cubic inch.
72,000	.0149	.....	
73,000	.0421	.....	
74,000	.0429	.....	
76,000	.0446	.....	
78,000	.0470	.....	
80,000	.0512	.....	
84,000	.0578	.....	
88,000	.0645	.....	
92,000	.0719	.....	
100,000	.09	.....	
108,000	.11	.....	
116,000	.14	.....	
128,000	.21	.....	
132,000	.30	.....	
132,800	.38	.....	Tensile strength.
0	.85	.....	= 8.7 per cent. Mechanical work necessary to produce rupture, 10,699 inch-pounds=892 foot-pounds per cubic inch.

Elongation of inch sections, ".08, ".11*, ".08*, ".08.
Diameter at fracture, ".76; area, .454 square inch.
Contraction of area, 9.2 per cent.
Appearance of fracture, fine granular.

STEEL BARS IMMERSED IN LIQUID AIR.

EXPERIMENTS WITH STEEL BARS IMMERSED IN LIQUID AIR.

The contraction of steel bars, of different chemical composition, was determined by the use of liquid air. Data points were established on specimens 3″.5 apart, and the contraction on these gauged lengths measured after the specimens had been immersed in liquid air. The air was poured over the specimens, placed singly in a shallow wooden tray, maintaining a supply of air until violent ebullition had ceased.

The interval of time of complete submersion was about three minutes. At the end of this time, and while the specimens were still submerged, the lengths between reference points were determined in the manner usual in the determination of initial strains in steel; that is, by means of a micrometer provided with conical contact points, one on each beam, which enter small drilled holes made in the specimen. A change in the distance between reference points is measured by the micrometer when thus centered on the specimen.

The tensile strength of one specimen was determined while in a bath of liquid air, after submersion of about three minutes succeeding the interval of violent ebullition.

Measurements on the contraction of the steel bars gave the following results, the initial temperature of the bars being 70° F.

BARS IMMERSED IN LIQUID AIR.

Chemical composition.					Contraction.	
Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	In length of 3″.5.	Per linear inch.
.16	.61	.04	.067	.070	.0063	.00180
.34	.65	.34	.057	.048	.0063	.00180
.55	.75	.14	.050	.034	.0062	.00177
.73	.64	.04	.048	.073	.0067	.00191
.82	.36	.10	.030	.043	.0064	.00183
1.09	.39	.11	.042	.032	.0066	.00184

The means of two observations are given above, which were identical or differed amounts not exceeding ″.0003, excepting with the bar .73C, in which the two observations were ″.0008 apart.

The tensile test was made with a bar of the following chemical composition:

Carbon	.17
Manganese	.57
Silicon	.04
Sulphur	.085
Phosphorus	.088

Dimensions of specimen: Diameter, ″.564=sectional area, .25 square inch, length of stem, 3″.

An initial load of 1,000 pounds tension was applied to the specimen after it was adjusted in the testing machine.

Liquid air was poured into the tray which inclosed the test piece.

The contractile force developed during the cooling of the specimen increased the initial load to 6,700 pounds tension, = 26,800 pounds per square inch on the stem.

TENSILE TEST.

Elastic limit, total, approximate	pounds..	20,000
Elastic limit, per square inch, approximate	do....	80,000
Tensile strength, total	do....	24,400
Tensile strength, per square inch	do....	97,600
Elongation in 2″, ″.32	per cent..	10.7
Diameter at fracture	″.41; area, .132 square inch; contraction, 47.2 per cent	
Elongation of inch sections	″.00, ″.03, ″.29*	
Appearance of fracture	fine granular, radiating from the center	
Load at time of rupture	pounds..	23,000

The elastic limit was judged of by the rapid yielding of the steel which occurred at the load above given.

Although an apparent elongation of 10.7 per cent was displayed by the test piece, this was due to the local elongation of the stem of the specimen at the place of rupture.

The inch section remote from the fractured one showed no permanent elongation.

A companion specimen, taken from the same bar as the specimen tested in liquid air, gave the following results when tested at 76° F., the temperature of the testing room:

Dimensions: Diameter, ″.564 = sectional area, .25 square inch; length of stem, 3″.

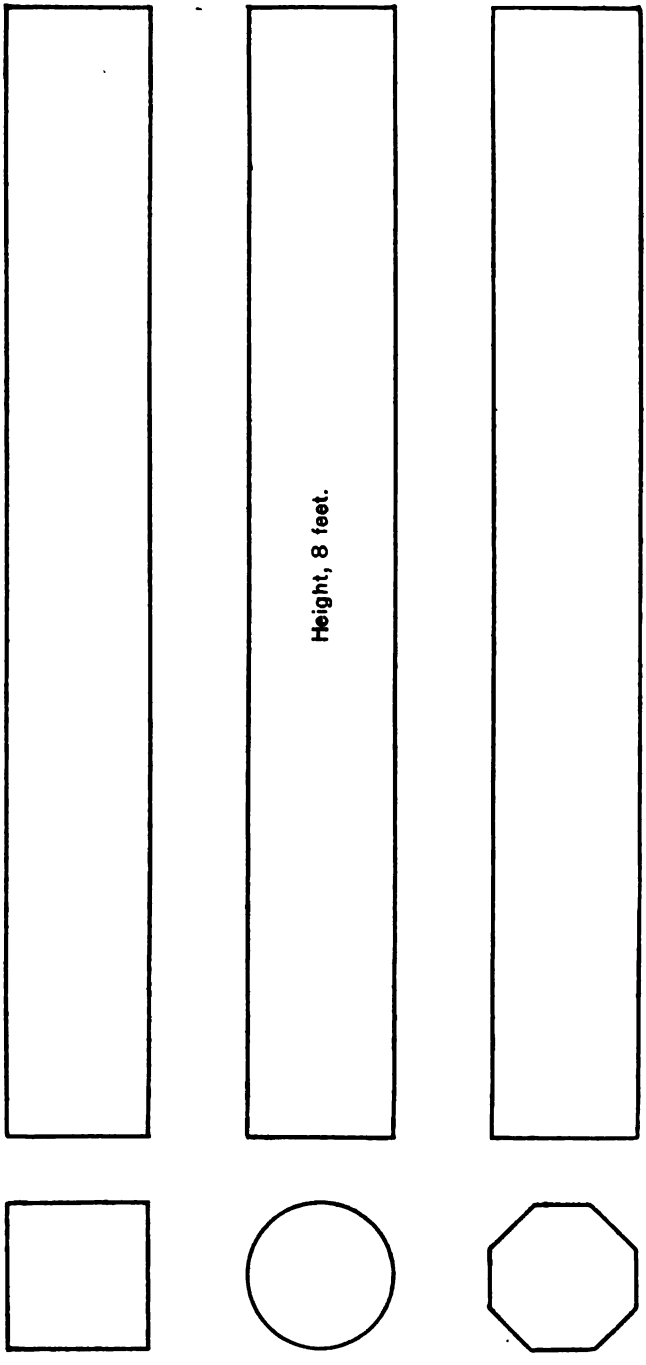
Elastic limit, total	pounds..	13,200
Elastic limit, per square inch	do....	52,800
Tensile strength, total	do....	18,000
Tensile strength, per square inch	do....	72,000
Elongation in 2″, ″.88	per cent..	29.3
Diameter at fracture	″.38; area, .1134 square inch; contraction, 54.6 per cent	
Elongation of inch sections	″.20, ″.48, *″.20	
Appearance of fracture	fine silky	

The gain in strength of the specimen tested in liquid air over the companion specimen tested at 76° F. is 35.5 per cent.

CONCRETE AND MORTAR COLUMNS,

PLAIN AND REËNFORCED WITH LONGITUDINAL STEEL BARS, AND CAGES OF EXPANDED METAL WITH AND WITHOUT STEEL LATHING.

REËNFORCING BARS EXTEND FROM END TO END OF THE COLUMNS.



Shapes of concrete and mortar columns.

Concrete and Mortar Columns.

Tests continued from report of 1904.

The columns were nominally 8 feet in height each, and in cross-section dimensions ranged from about 11″ to 14″.7 diameter for those of round or octagonal shape. The square columns were nominally 12″ by 12″, but overrunning these dimensions somewhat.

The mortar columns are placed first in the details of the tests and the tabulation, the plain columns preceding those which were provided with reënforcing steel bars. The columns are also arranged in the order of the richness of the mixtures. The reënforcing bars were ¾-inch square twisted steel bars, which extended from end to end of the columns and took full bearings on the platforms of the testing machine. The total compression movements of the mortar and of the steel bars was, therefore, the same for each while under loads.

The bars were maintained in place, within the column, against lateral deflection by the strength of the mortar.

The longitudinal compression of the columns was determined by measurements on a gauged length of 50″ established symmetrically on their lengths. After each increment of load the sets were determined, returning to the initial load. At intervals some of the earlier loads were repeated, the compressibility of the material thus being determined after different degrees of loading.

The columns were built in upright position. They were tested in a horizontal one.

During the transportation to the testing machine and adjustment therein, they were placed under compression by means of end plates and side rods with turn-buckles. The loads which were applied in this manner before testing are entered in the column of remarks for each test.

Observations were made, with certain of the columns, on the lateral expansion of the mortar, which accompanies the direct compression of the material. Transverse gauged lengths, of 10″ each, were established at different places along the length of the column and measurements made at each of these.

The concrete columns were treated in the same manner as the mortar columns. Crushed stone (trap rock), pebbles, and cinders were used in the composition of the concretes, the proportions of which were varied. The richest concrete was a 1:1:2 mixture; the leanest a 1:3:6 mixture.

There were two groups of reënforced concrete columns. In one, the metal reënforcement consisted of longitudinal steel bars, the same as described for the mortar columns. In the other group the reënforcing was by means of expanded metal cages of 10″ or 12″ diameter, within which the concrete was placed. Some of the cages were wrapped with steel lathing. The lathing was also of expanded metal but of finer mesh and thinner gauge of metal, with respect to its thickness, than the metal of larger mesh.

In the construction of the columns, those which were provided with the finer mesh lathing were made without the use of wooden molds. The concrete was tamped in place and the surface smoothed off with a trowel even with the outside of the wrapping of lathing. A number of the columns were subsequently plastered with a coating of mortar,

applied over the lathing. This was done on the day following the construction of the column.

When expanded metal was used without lathing the columns were made within wooden molds. Two only of this type are comprised in the present tests, each of these being octagonal in cross section.

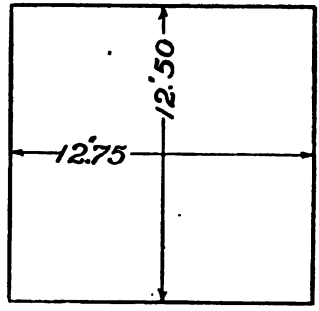
In addition to the cages there were a number of this group of columns further reënforced with longitudinal steel bars of small size. They were plain, round or square steel bars, $\frac{1}{4}''$ square, $\frac{9}{16}''$ round, and $\frac{5}{8}''$ square, respectively.

Following the details and tabulated results are some deduced results on the behavior of the longitudinal bars of the first group of reënforced columns.

No. 1682.

1:2 mixture.

Mortar column, plain, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 2.

Age, set in air, 6 months.

Weight of column, total, 1,138 pounds.

Weight of mortar, 1,138 pounds=130.4 pounds per cubic foot.

Height of column, 94.60 inches.

Sectional area of column, gross, 12″.75 × 12″.50 = 159.38 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,938	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
23,907	150	.0015	.0004	
31,876	200	.0028	.0008	
39,845	250	.0039	.0009	
47,814	300	.0050	.0010	
55,783	350	.0059	.0010	
63,752	400	.0070	.0012	
71,721	450	.0080	.0012	
79,690	500	.0090	.0013	
87,659	550	.0100	.0014	
95,628	600	.0109	.0015	E (100–600) = 2,660,000 pounds per square inch.
.....	600	.0110	.0015	
111,566	700	.0129	.0017	
127,504	800	.0147	.0018	
143,442	900	.0165	.0019	
159,380	1,000	.0185	.0021	E (600–1,000) = 2,857,000 pounds per square inch.
.....	600	.0119	.0020	
.....	600	.0119	.0020	
175,318	1,100	.0200	.0021	
191,256	1,200	.0221	.0022	
207,194	1,300	.0237	.0025	
223,132	1,400	.0255	.0026	
239,070	1,500	.0275	.0028	E (1,000–1,500) = 3,012,000 pounds per square inch.
.....	600	.0128	.0028	
.....	600	.0125	.0029	
255,008	1,600	.0295	.0037	
270,946	1,700	.0318	.0040	
286,884	1,800	.0340	.0044	

No. 1682—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
302,822	1,900	.0365	.0051	
318,760	2,000	.0387	.0057	E (1,500–2,000) = 3,012,000 pounds per square inch.
.....	600	.0154	.0054	
.....	600	.0158	.0054	Rested 1 hour.
.....	600	.0151	.....	
.....	1,000	.0221	.....	
.....	1,500	.0304	.....	
.....	2,000	.0394	.....	
.....	1,500	.0319	.....	
.....	1,000	.0240	.....	
.....	600	.0170	.0062	
.....	600	.0161	.0062	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At ⅛ diameter (3″) from upper end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0001	.....	
.....	1,000	.0003	.....	
.....	1,500	.0005	0.	
At ¼ diameter (6″) from upper end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0001	.....	
.....	1,000	.0003	.....	
.....	1,500	.0006	0.	
At ¾ diameter (9″) from upper end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0003	.....	
.....	1,000	.0006	.....	
.....	1,500	.0008	0.	
At 1 diameter (12″) from upper end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0001	.....	
.....	1,000	.0003	.....	
.....	1,500	.0007	0.	
At 2 diameters (24″) from upper end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0003	.....	
.....	1,000	.0006	.....	
.....	1,500	.0009	0.	
At 3 diameters (36″) from upper end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0003	.....	
.....	1,000	.0007	.....	
.....	1,500	.0010	0.	
At middle of height of column.				
.....	100	0.	0.	Initial load.
.....	600	.0003	.....	
.....	1,000	.0004	.....	
.....	1,500	.0007	—.0001	
Measurements of lateral expansion of column discontinued.				
582,000	3,652	.....	.....	Ultimate strength.

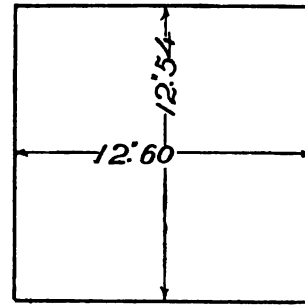
A wedge-shaped fragment, 3 feet long, developed at the lower end of the column.

Longitudinal cracks extended to the middle of height of column.

Sudden fracture.

No. 1684.

1:2 mixture.
Mortar column, plain, without reinforcing metal.



Composition, by volume: Alpha cement, 1: sand, 2.
Age, set in air, 6 months 3 days.
Weight of column, total, 1,125 pounds.
Weight of mortar, 1,125 pounds = 129.6 pounds per cubic foot.
Height of column, 94.90 inches.
Sectional area of column, gross, 12″.60 × 12″.54 = 158 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,800	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
23,700	150	.0008	0.	
31,600	200	.0016	0.	
39,500	250	.0025	0.	
47,400	300	.0034	0.	
55,300	350	.0043	0.	
63,200	400	.0051	0.	
71,100	450	.0060	0.	
79,000	500	.0070	0.	
86,900	550	.0079	.0001	
94,800	600	.0087	.0002	E (100–600) = 2,941,000 pounds per square inch.
.....	600	.0087	.0002	Rested under initial load 16 hours.
.....	600	.0088	.0002	
110,600	700	.0105	.0003	
126,400	800	.0123	.0004	
142,200	900	.0148	.0008	
158,000	1,000	.0161	.0009	E (600–1,000) = 2,985,000 pounds per square inch.
.....	600	.0094	.0009	
.....	600	.0094	.0009	
173,800	1,100	.0180	.0012	
189,600	1,200	.0200	.0014	
205,400	1,300	.0221	.0017	
221,200	1,400	.0240	.0021	
237,000	1,500	.0260	.0023	E (1,000–1,500) = 2,941,000 pounds per square inch.
.....	600	.0109	.0023	
.....	600	.0108	.0021	
252,800	1,600	.0279	.0025	
268,600	1,700	.0300	.0027	
284,400	1,800	.0320	.0029	
300,200	1,900	.0341	.0032	
316,000	2,000	.0361	.0035	E (1,500–2,000) = 2,809,000 pounds per square inch.

No. 1684—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0121	.0035	
.....	600	.0121	.0035	
331,800	2,100	.0379	.0034	
347,600	2,200	.0404	.0039	
363,400	2,300	.0427	.0044	
379,200	2,400	.0453	.0049	
395,000	2,500	.0479	.0055	E (2,000–2,500)=2,551,000 pounds per square inch.
.....	600	.0144	.0055	
.....	600	.0144	.0050	
.....	600	.0144	.....	
.....	1,000	.0219	.....	
.....	2,000	.0371	.....	
.....	2,500	.0464	.....	
.....	2,000	.0389	.....	
.....	1,000	.0288	.....	
.....	600	.0170	.0061	
.....	600	.0154	.....	
.....	1,000	.0230	.....	
.....	1,500	.0320	.....	
.....	2,000	.0392	.....	
.....	2,500	.0472	.....	
.....	2,000	.0395	.....	
.....	1,500	.0324	.....	
.....	1,000	.0246	.....	
.....	600	.0180	.0070	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

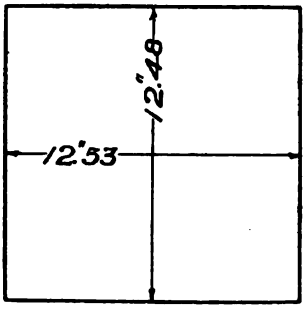
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0007	.....	
.....	1,000	.0017	.....	
.....	1,500	.0030	.....	
.....	2,000	.0040	.....	
.....	1,500	.0039	.....	
.....	1,000	.0031	.....	
.....	600	.0022	.0004	
.....	2,000	.0046	.0004	
.....	2,000	.0046	.0005	
At 2 diameters (24″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0002	.....	
.....	1,000	.0007	.....	
.....	1,500	.0010	.....	
.....	2,000	.0016	.....	
.....	1,500	.0010	.....	
.....	1,000	.0007	.....	
.....	600	.0004	0.	
At 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0002	.....	
.....	1,000	.0005	.....	
.....	1,500	.0008	.....	
.....	2,000	.0012	.....	
.....	1,500	.0010	.....	
.....	1,000	.0007	.....	
.....	600	.0002	0.	
At 4 diameters (at middle) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0003	.....	
.....	1,000	.0005	.....	
.....	1,500	.0009	.....	
.....	2,000	.0012	0.	
At 5 diameters (60″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0002	.....	
.....	1,000	.0005	.....	
.....	1,500	.0008	.....	
.....	2,000	.0010	0.	
At 6 diameters (72″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0002	.....	
.....	1,000	.0005	.....	
.....	1,500	.0008	.....	
.....	2,000	.0010	0.	
At 7 diameters (84″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	0.	.....	
.....	1,000	.0002	.....	
.....	1,500	.0005	.....	
.....	2,000	.0008	0.	
Measurements of lateral expansion of column discontinued.				
398,100	2,488	.....	.....	Column failed upon reapplying this load
395,000	2,500	.....	.....	Ultimate strength. The maximum stress was reached on earlier loading.

Failed at end of column, detaching wedge-shaped fragment 24″ long.

No. 1680.

1:3 Mixture.

Mortar column, plain, without reënforcing metal.



Composition, by volume: Alpha cement, 1: sand 3.

Age, set in air, 5 months 26 days.

Weight of column, total, 1,080 pounds.

Weight of mortar, 1,080 pounds = 125.7 pounds per cubic foot.

Height of column 94.90 inches.

Sectional area of column, gross, 12".53 × 12".48 = 156.37 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,637	100	0.	0.	Initial load. Loaded with 15,000 pounds before testing.
23,456	150	.0008	0.	
31,274	200	.0017	0.	
39,093	250	.0028	0.	
46,911	300	.0038	0.	
54,730	350	.0047	0.	
62,548	400	.0070	.0001	
70,367	450	.0078	.0002	
78,185	500	.0088	.0003	
86,004	550	.0097	.0003	
93,822	600	.0108	.0003	E (100-600) = 2,381,000 pounds per square inch
.....	600	.0107	.0005	
109,459	700	.0129	.0005	
125,096	800	.0150	.0006	
140,733	900	.0174	.0009	
156,370	1,000	.0195	.0013	E (600-1,000) = 2,597,000 pounds per square inch.
.....	600	.0125	.0014	
.....	600	.0120	.0014	
.....	600	.0120	.0016	
.....	600	.0130	.0014	
172,007	1,100	.0216	.0014	
187,644	1,200	.0240	.0017	
203,281	1,300	.0269	.0022	
218,918	1,400	.0298	.0029	
234,555	1,500	.0330	.0035	
.....	100	0.	0.	Micrometer removed, returned and reset at zero.
.....	600	.0096	0.	
.....	600	.0096	0.	
.....	600	.0096	.....	
.....	1,000	.0185	.....	
.....	1,500	.0310	.....	
.....	1,000	.0206	.....	
.....	600	.0121	.0009	
.....	600	.0106	.0009	

Measurements of longitudinal compression of column discontinued.
Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, at different places along its length.

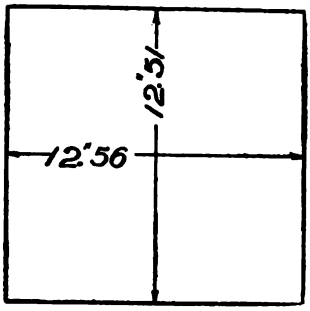
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At one end of 50″ longitudinal gauged length.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0001	.....	
.....	600	.0002	.....	
.....	800	.0003	.....	
.....	1,000	.0005	.....	
.....	1,200	.0007	.....	
.....	1,400	.0010	0.	
At middle of height of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	0.	.....	
.....	600	.0001	.....	
.....	800	.0002	.....	
.....	1,000	.0003	.....	
.....	1,200	.0004	−.0001	
.....	1,200	.0004	−.0001	
At other end of 50″ longitudinal gauged length.				
.....	100	0.	0.	
.....	200	0.	.....	
.....	400	0.	.....	
.....	600	.0001	.....	
.....	800	.0003	.....	
.....	1,000	.0004	.....	
.....	1,200	.0006	0.	
Measurements of lateral expansion of column discontinued.				
322,500	2,062	.....	.....	Ultimate strength.

Failed at a place 32″ from upper end of column
Opened an oblique crack.

No. 1681.

1:3 mixture.

Mortar column, plain, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 3.

Age, set in air, 5 months 27 days.

Weight of column, total, 1,097 pounds.

Weight of mortar, 1,097 pounds = 127.1 pounds per cubic foot.

Height of column, 94.90 inches.

Sectional area of column, gross, 12″.51 × 12″.56 = 157.13 square inches.

Gauged length, 50″.

Applied loads.		In guaged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,718	100	0.	0.	Initial load. Loaded with 11,000 pounds before testing.
23,570	150	.0010	.0001	
31,426	200	.0023	.0002	
39,283	250	.0034	.0003	
47,139	300	.0044	.0004	
54,996	350	.0056	.0005	
62,852	400	.0068	.0005	
70,709	450	.0078	.0006	
78,565	500	.0089	.0007	
86,422	550	.0100	.0007	
94,278	600	.0111	.0008	E (100–600) = 2,427,000 pounds per square inch.
.....	600	.0111	.0009	
109,991	700	.0131	.0009	
125,704	800	.0155	.0011	
141,417	900	.0178	.0012	
157,130	1,000	.0201	.0017	E (600–1,000) = 2,469,000 pounds per square inch.
.....	600	.0124	.0018	
.....	600	.0125	.0019	
172,843	1,100	.0228	.0024	
188,556	1,200	.0253	.0027	
204,269	1,300	.0280	.0031	
219,982	1,400	.0305	.0035	
235,695	1,500	.0335	.0041	E (1,000–1,500) = 2,273,000 pounds per square inch.
.....	600	.0150	.0041	
.....	600	.0148	.0041	
251,408	1,600	.0368	.0047	
267,121	1,700	.0398	.0058	
282,834	1,800	.0427	.0062	

No. 1681—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	000	.0167	.0059	
.....	600	.0168	.0059	
.....	600	.0166	.....	
.....	1,000	.0251	.....	
.....	1,500	.0362	.....	
.....	1,000	.0270	.....	
.....	600	.0187	.0068 .0065	Rested under initial load 16 hours.
.....	600	.0170	.....	
.....	1,000	.0256	.....	
.....	1,500	.0369	.....	
.....	1,000	.0276	.....	
.....	600	.0195	.0076	
.....	600	.0178	.0071	
.....	600	.0178	.0071	
.....	600	.0178	.0071	
.....	1,000	.0262	.0071	
.....	1,000	.0261	.0071	
.....	1,000	.0263	.0071	
.....	1,500	.0372	.0074	
.....	1,500	.0374	.0076	
.....	1,500	.0375	.0077	
.....	1,500	.0377	.0078	
.....	1,500	.0377	.0079	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

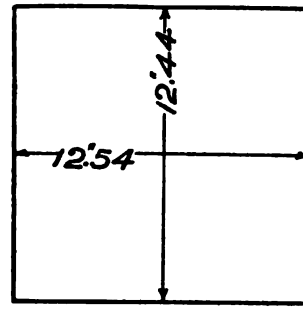
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At one end of 50″ longitudinal gauged length.				
.....	100	0.	0.	Initial load.
.....	600	.0004	.....	
.....	1,000	.0006	.....	
.....	1,500	.0009	.....	
.....	1,000	.0007	.....	
.....	600	.0004	0.	
At middle of height of column.				
.....	100	0.	0.	Initial load.
.....	600	.0004	.....	
.....	1,000	.0007	.....	
.....	1,500	.0010	.....	
.....	1,000	.0008	.....	
.....	600	.0005—	0.	
At other end of 50″ longitudinal gauged length.				
.....	100	0.	0.	Initial load.
.....	600	.0002	.....	
.....	1,000	.0004	.....	
.....	1,500	.0008—	.....	
.....	1,000	.0005	.....	
.....	600	.0002	0.	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0001+	.....	
.....	1,000	.0005	.....	
.....	1,500	.0008	.....	
.....	1,000	.0006	.....	
.....	600	.0005	.0001—	
At ½ diameter (6″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0001+	.....	
.....	1,000	.0004	.....	
.....	1,500	.0009	.....	
.....	1,000	.0005	.....	
.....	600	.0002	0.	
At ¼ diameter (3″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0001—	.....	
.....	1,000	.0003—	.....	
.....	1,500	.0005	.....	
.....	1,000	.0003	.....	
.....	600	0.	0.	
Measurements of lateral expansion of column discontinued.				
423,000	2,692	.....	.....	Ultimate strength.

A wedge-shaped fragment 29″ long developed at the lower end of the column. A central longitudinal crack extended from the wedge-shaped piece to the middle of the length of the column, where transverse fractures detached the lower fragments, leaving the upper half of the column intact.

No. 1679.

1:4 mixture.

Mortar column, plain, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 4.
Age, set in air, 5 months 21 days.
Weight of column, total, 1,052 pounds.
Weight of mortar, 1,052 pounds=122.9 pounds per cubic foot.
Height of column, 94.85 inches.
Sectional area of column, gross, 12''.44×12''.54=156 square inches.
Gauged length, 50''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,600	100	0.	0.	Initial load. Loaded with 13,000 pounds before testing.
23,400	150	.0017	.0004	
31,200	200	.0033	.0005	
39,000	250	.0045	.0006	
46,800	300	.0060	.0008	
54,600	350	.0076	.0009	
62,400	400	.0090	.0011	Rested under initial load 1 hour. Change in temperature.
70,200	450	.0109	.0017	
78,000	500	.0128	.0019	
85,800	550	.0142	.0021	
93,600	600	.0158	.0024	E (100–600)=1,866,000 pounds per square inch.
.....	600	.0160	.0024	
101,400	650	.0175	.0025	
109,200	700	.0195	.0029	
117,000	750	.0209	.0031	
124,800	800	.0227	.0036	
132,600	850	.0244	.0038	
140,400	900	.0266	.0042	
148,200	950	.0289	.0048	
156,000	1,000	.0315	.0058	E (600–1,000)=1,626,000 pounds per square inch.
.....	600	.0202	.0055	
.....	600	.0201	.0056	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length:

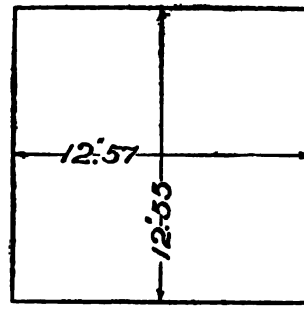
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At one end of 50″ longitudinal gauged length.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0001	.....	
.....	600	.0003	.....	
.....	800	.0005	.....	
.....	1,000	.0007	0.	
At middle of height of column.				
.....	100	0.	0.	Initial load
.....	200	0.	.....	
.....	400	.0003	.....	
.....	600	.0004	.....	
.....	800	.0006	.....	
.....	1,000	.0009	.0001	
.....	1,000	.0009	.0001	
At other end of 50″ longitudinal gauged length				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0001	.....	
.....	600	.0003	.....	
.....	800	.0006	.....	
.....	1,000	.0007	0.	
.....	1,000	.0007	0.	
Measurements of lateral expansion of column discontinued.				
244,000	1,564	.....	.....	Ultimate strength.

Oblique fracture, 28″ from lower end of column.

No. 1685.

1:4 mixture.

Mortar column, plain, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 4.

Age, set in air, 6 months 9 days.

Weight of columm, total, 1,060 pounds.

Weight of mortar, 1,060 pounds=122.3 pounds per cubic foot.

Height of column, 95 inches.

Sectional area of column, gross, 12″.57 × 12″.55=157.75 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,775	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
23,662	150	.0013	0.	
31,550	200	.0028	0.	
39,438	250	.0042	.0001	
47,325	300	.0058	.0002	
55,213	350	.0074	.0008	
63,100	400	.0090	.0005	
70,988	450	.0104	.0008	
78,875	500	.0121	.0011	
86,763	550	.0138	.0013	
94,650	600	.0155	.0016	E (100–600)=1,799,000 pounds per square inch.
.....	600	.0158	.0017	
102,538	650	.0175	.0020	
110,425	700	.0191	.0023	
118,313	750	.0212	.0029	
126,200	800	.0231	.0033	
134,088	850	.0252	.0038	
141,975	900	.0275	.0044	
149,863	950	.0298	.0049	
157,750	1,000	.0325	.0056	E (600–1,000)=1,588,000 pounds per square inch.
.....	600	.0206	.0055	
.....	600	.0206	.0056	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

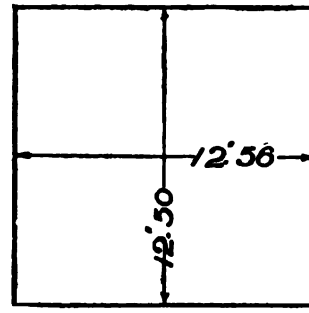
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0002	.....	
.....	400	.0005	.....	
.....	600	.0008	.....	
.....	800	.0010	.....	
.....	1,000	.0015	.....	
.....	800	.0012	.....	
.....	600	.0010	.....	
.....	400	.0007	.....	
.....	200	.0003	0.	
At 2 diameters (24″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0003	.....	
.....	600	.0005	.....	
.....	800	.0007	.....	
.....	1,000	.0009	0.	
At 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0003	.....	
.....	600	.0005	.....	
.....	800	.0008	.....	
.....	1,000	.0011	0.	
At 4 diameters (at middle) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0004	.....	
.....	800	.0006	.....	
.....	1,000	.0010	0.	
At 5 diameters (60″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0005	.....	
.....	800	.0007	.....	
.....	1,000	.0009	0.	
At 6 diameters (72″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0003	.....	
.....	600	.0006	.....	
.....	800	.0008	.....	
.....	1,000	.0011	0.	
At 7 diameters (84″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0002	.....	
.....	400	.0005	.....	
.....	600	.0007	.....	
.....	800	.0010	.....	
.....	1,000	.0014	.....	
.....	1,000	.0014	.....	
Measurements of lateral expansion of column discontinued.				
232,100	1,471	.....	.....	Ultimate strength.

Failed at lower end of column.

Oblique crack 1 foot to 3 feet from end of column.

No. 1686.

1:5 mixture.
Mortar column, plain, without reënforcing metal.



Composition, by volume: Alpha cement, 1: sand, 5.
Age, set in air, 6 months 9 days.
Weight of column, total, 1,034 pounds.
Weight of mortar, 1,034 pounds=119.7 pounds per cubic foot.
Height of column, 95.05 inches.
Sectional area of column, gross, 12".50×12".56=157 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,700	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
23,550	150	.0014	.0002	
31,400	200	.0031	.0004	
39,250	250	.0050	.0006	
47,100	300	.0069	.0009	
54,950	350	.0090	.0012	
62,800	400	.0109	.0015	
70,650	450	.0130	.0018	
78,500	500	.0155	.0024	
86,350	550	.0180	.0030	
94,200	600	.0206	.0037	E (100-600)=1,479,000 pounds per square inch.
.....	600	.0212	.0041	
.....	600	.0215	.0045	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

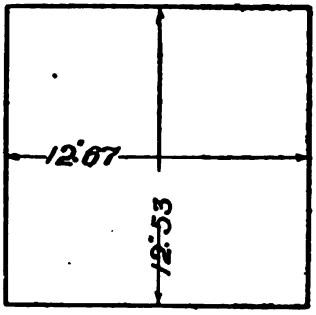
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0002	.....	
.....	400	.0006	.....	
.....	600	.0010	.....	
.....	400	.0007	.....	
.....	200	.0004	.0001	
.....	600	.0010	.0002	
At 2 diameters (24″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0005	.....	
.....	600	.0009	0.	
At 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0005	0.	
At 4 diameters (at middle) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0003	.....	
.....	600	.0005	0.	
At 5 diameters (60″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0002	.....	
.....	400	.0005	.....	
.....	600	.0007	0.	
At 6 diameters (72″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0003	.....	
.....	600	.0005	0.	
At 7 diameters (84″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0003	.....	
.....	600	.0005	0.	
Measurements of lateral expansion of column discontinued.				
168,000	1,088	.....	.....	Ultimate strength.

Column failed with oblique fractures between 2 and 3 feet from lower end of column.

No. 1687.

1:5 mixture.

Mortar column, plain, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 5.

Age, set in air, 6 months 18 days.

Weight of column, total, 1,050 pounds.

Weight of mortar, 1,050 pounds=120.1 pounds per cubic foot.

Height of column, 95.10 inches.

Sectional area of column, gross, 12″.67×12″.53=158.76 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,876	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
23,814	150	.0013	0.	
31,752	200	.0029	0.	
39,690	250	.0044	.0001	
47,628	300	.0060	.0003	
55,566	350	.0080	.0005	
63,504	400	.0098	.0006	
71,442	450	.0118	.0009	
79,380	500	.0141	.0014	
87,318	550	.0164	.0018	
95,256	600	.0188	.0024	E (100-600)=1,524,000 pounds per square inch.
.....	600	.0194	.0027	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

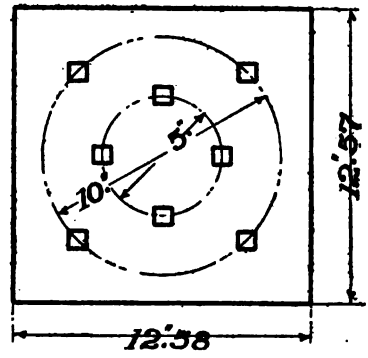
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0002	.....	
.....	400	.0005	.....	
.....	600	.0008	.0001	
.....	600	.0008	.0001	
At 2 diameters (24″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0005	0.	
At 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0005	.....	
.....	600	.0008	0.	
At 4 diameters (at middle) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0003	.....	
.....	600	.0005	0.	
At 5 diameters (60″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0004	0.	
At 6 diameters (72″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0003	.....	
.....	600	.0005	0.	
At 7 diameters (84″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0005	0.	
Measurements of lateral expansion of column discontinued.				
171,800	1,062	.....	.....	Ultimate strength.

Column failed near middle of its height, the principal fracture being located 42″ from lower end.

No. 1673.

1:2 mixture.

Mortar column, reënforced with 8 twisted steel bars, each 95 inches long.



Composition, by volume: Alpha cement, 1; sand, 2.
Age, set in air, 5 months 10 days.
Weight of column, total, 1,200 pounds.
Weight of mortar, 1,079 pounds=127.7 pounds per cubic foot.
Weight of steel bars, 121 pounds.
Height of column, 95 inches.
Sectional area of column, gross, 12".58×12".57=158.13 square inches.
Sectional area of steel bars, ".75×".75=□".5625×8=4.5 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,813	100	0.	0.	Initial load. Loaded with 11,000 pounds before testing.
28,720	150	.0013	.0001	
31,626	200	.0022	.0003	
39,533	250	.0034	.0005	
47,439	300	.0046	.0005	
55,346	350	.0058	.0006	
63,252	400	.0069	.0007	
71,159	450	.0082	.0008	
79,065	500	.0094	.0009	
86,972	550	.0105	.0010	
94,878	600	.0118	.0010	E (100-600)=2,815,000 pounds per square inch.
.....	600	.0119	.0011	
110,691	700	.0140	.0012	
126,504	800	.0162	.0013	
142,317	900	.0184	.0015	
158,130	1,000	.0204	.0016	E (600-1,000) = 2,500,000 pounds per square inch.
.....	600	.0130	.0016	
.....	600	.0130	.0017	
173,943	1,100	.0225	.0019	
189,756	1,200	.0247	.0020	
205,569	1,300	.0265	.0021	
221,382	1,400	.0283	.0023	
237,195	1,500	.0306	.0025	E (1,000-1,500)=2,688,000 pounds per square inch.
.....	600	.0141	.0024	
.....	600	.0140	.0025	

No. 1673—Continued.

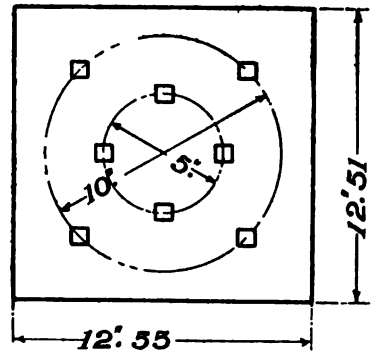
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
258,008	1,600	.0326	.0026	
268,821	1,700	.0344	.0028	
284,634	1,800	.0364	.0030	
300,447	1,900	.0385	.0032	
316,260	2,000	.0404	.0034	E (1,500-2,000) = 2,809,000 pounds per square inch.
.....	600	.0153	.0034	
.....	600	.0153	.0034	
332,073	2,100	.0424	.0035	
347,886	2,200	.0446	.0038	
363,699	2,300	.0466	.0040	
379,512	2,400	.0486	.0040	
395,325	2,500	.0508	.0044	E (2,000-2,500) = 2,660,000 pounds per square inch.
.....	600	.0166	.0042	
.....	600	.0166	.0043	
411,138	2,600	.0530	.0045	
426,951	2,700	.0551	.0047	
442,764	2,800	.0574	.0050	
458,577	2,900	.0598	.0053	
474,390	3,000	.0622	.0055	E (2,500-3,000) = 2,427,000 pounds per square inch.
.....	600	.0180	.0053	
.....	600	.0180	.0052	
490,203	3,100	.0651	.0056	
506,016	3,200	.0679	.0061	
521,829	3,300	.0702	.0064	
537,642	3,400	.0730	.0071	
553,455	3,500	.0762	.0074	E (3,000-3,500) = 2,066,000 pounds per square inch.
.....	600	.0210	.0073	
.....	600	.0208	.0078	
569,268	3,600	.0798	.0080	
585,081	3,700	.0830	.0086	
600,894	3,800	.0871	.0099	
616,707	3,900	.0910	.0105	
632,520	4,000	.0952	.0124	E (3,500-4,000) = 1,786,000 pounds per square inch.
.....	600	.0270	.0121	
.....	600	.0268	.0119	
648,333	4,100	.0997	.0143	
664,146	4,200	.....	.....	Ultimate strength.

The maximum load was sustained momentarily, the mortar then cracked, a pyramidal fracture developing at the upper end of the column, and longitudinal lines of fractures extended from this end to the middle of its height. Three twisted bars bent outward at a distance of 9″ from the upper end and one bar at a distance of 20″. The inner group of four bars buckled at a distance of about 12″ to 14″ from the upper end.

No. 1690.

1:3 mixture.

Mortar column, reënforced with 8 twisted steel bars, each 95.45 inches long.



Composition, by volume: Alpha cement, 1; sand, 3.
Age, set in air, 7 months 21 days.
Weight of column, total, 1,181 pounds.
Weight of mortar, 1,060 pounds = 125.9 pounds per cubic foot.
Weight of steel bars, 121 pounds.
Height of column, 95.45 inches.
Sectional area of column, gross, 12".51 × 12".55 = 157 square inches.
Sectional area of steel bars, ".75 × ".75 = □".5625 × 8 = 4.5 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,700	100	0.	0.	Initial load. Loaded with 14,000 pounds before testing.
23,550	150	.0010	0.	
31,400	200	.0021	.0001	
39,250	250	.0033	.0008	
47,100	300	.0044	.0003	
54,950	350	.0058	.0004	
62,800	400	.0071	.0005	
70,650	450	.0083	.0007	
78,500	500	.0096	.0008	
86,350	550	.0108	.0008	
94,200	600	.0120	.0009	E (100–600) = 2,252,000 pounds per square inch.
.....	600	.0120	.0009	
109,900	700	.0143	.0010	
125,600	800	.0167	.0011	
141,300	900	.0189	.0013	
157,000	1,000	.0211	.0014	E (600–1,000) = 2,326,000 pounds per square inch.
.....	600	.0130	.0014	
.....	600	.0130	.0014	
172,700	1,100	.0232	.0015	
188,400	1,200	.0253	.0016	
204,100	1,300	.0275	.0018	
219,800	1,400	.0298	.0020	
235,500	1,500	.0320	.0021	E (1,000–1,500) = 2,451,000 pounds per square inch.
.....	600	.0141	.0021	
.....	600	.0141	.0021	

No. 1690—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
251,200	1,600	.0343	.0025	
266,900	1,700	.0364	.0027	
282,600	1,800	.0388	.0030	
298,300	1,900	.0411	.0032	
314,000	2,000	.0433	.0035	E(1,500–2,000)=2,525,000 pounds per square inch.
.....	600	.0156	.0034	
.....	600	.0153	.0035	
329,700	2,100	.0458	.0038	
345,400	2,200	.0480	.0040	
361,100	2,300	.0505	.0044	
376,800	2,400	.0534	.0047	
392,500	2,500	.0561	.0050	E(2,000–2,500)=2,212,000 pounds per square inch.
.....	600	.0178	.0050	
.....	600	.0178	.0050	
408,200	2,600	.0589	.0055	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0003	.....	
.....	800	.0005	.....	
.....	1,000	.0006	.....	
.....	1,500	.0010	.....	
.....	2,000	.0014	.....	
.....	1,500	.0010	.....	
.....	1,000	.0008	.....	
.....	600	.0005	.....	
.....	400	.0003	.....	
.....	200	.0002	.0001	
At 2 diameters (24″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	.0001	.....	
.....	600	.0003	.....	
.....	1,000	.0005	.....	
.....	1,500	.0010	.....	
.....	2,000	.0013	.....	
.....	1,000	.0007	0.	
At 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	.0001	.....	
.....	600	.0003	.....	
.....	1,000	.0005	.....	
.....	1,500	.0008	.....	
.....	2,000	.0012	0.	
At middle of height of column.				
.....	100	0.	0.	Initial load.
.....	400	0.	.....	
.....	600	0.	.....	
.....	1,000	.0002	.....	
.....	1,500	.0005	.....	
.....	2,000	.0009	.0001	
At 5 diameters (60″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	.0001	.....	
.....	600	.0002	.....	
.....	1,000	.0005	.....	
.....	1,500	.0007	.....	
.....	2,000	.0011	0.	
At 6 diameters (72″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	0.	.....	
.....	600	0.	.....	
.....	1,000	.0001	.....	
.....	1,500	.0004	.....	
.....	2,000	.0006	0.	
At 7 diameters (84″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	0.	.....	
.....	600	0.	.....	
.....	1,000	.0002	.....	
.....	1,500	.0004	.....	
.....	2,000	.0006	0.	

Measurements of lateral expansion of column discontinued.

523,000 pounds=3,331 pounds per square inch applied and released to the initial load, after which the column rested 16 hours, when observations were resumed on longitudinal compression.

Original gauged length of 50″ used, resetting the micrometer at zero.

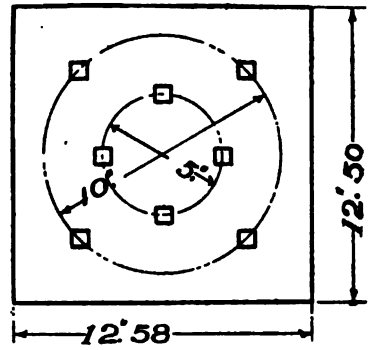
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,700	100	0.	0.	Initial load.
.....	200	.0022	.....	
.....	400	.0079	.....	
.....	600	.0187	.....	
.....	800	.0190	.....	
.....	1,000	.0232	.0003	
.....	1,200	.0285	.....	
.....	1,400	.0327	.....	
.....	1,600	.0368	.....	
.....	1,800	.0409	.....	
.....	2,000	.0450	.0007	
.....	2,200	.0494	.....	
.....	2,400	.0534	.....	
408,200	2,600	.0576	.....	
439,600	2,800	.0616	.....	
471,000	3,000	.0663	.....	
.....	2,800	.0637	.....	
.....	2,600	.0606	.....	
.....	2,400	.0571	.....	
.....	2,200	.0538	.....	
.....	2,000	.0503	.....	
.....	1,800	.0466	.....	
.....	1,600	.0428	.....	
.....	1,400	.0387	.....	
.....	1,200	.0347	.....	
.....	1,000	.0300	.....	
.....	800	.0248	.....	
.....	600	.0188	.....	
.....	400	.0120	.....	
.....	200	.0068	.0028 .0019	Set after resting 6 minutes.
603,000	3,841	.....	.....	Ultimate strength.

Column failed 1 foot from the upper end. Reënforcing bars buckled at the time of reaching the maximum load.

No. 1691.

1:4 mixture.

Mortar column, reënforced with 8 twisted steel bars, each 95.10 inches long.



Composition, by volume: Alpha cement, 1; sand, 4.

Age, set in air, 7 months 25 days.

Weight of column, total, 1,163 pounds.

Weight of mortar, 1,042 pounds=123.9 pounds per cubic foot.

Weight of steel bars, 121 pounds.

Height of column, 95.10 inches.

Sectional area of column, gross, 12".50 x 12".58=157.25 square inches.

Sectional area of steel bars, ".75 x ".75=□".5625 x 8=4.5 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,725	100	0.	0.	Initial load. Loaded with 15,000 pounds before testing.
23,588	150	.0014	.0001	
31,450	200	.0080	.0002	
39,313	250	.0050	.0004	
47,175	300	.0069	.0005	
55,088	350	.0088	.0007	
62,900	400	.0104	.0008	
70,763	450	.0122	.0008	
78,625	500	.0138	.0009	
86,488	550	.0155	.0010	
94,350	600	.0169	.0010	E (100-600)=1,572,000 pounds per square inch.
.....	600	.0172	.0011	
110,075	700	.0198	.0011	
125,800	800	.0223	.0012	
141,525	900	.0248	.0015	
157,250	1,000	.0272	.0016	E (600-1,000)=2,041,000 pounds per square inch.
.....	600	.0188	.0015	
.....	600	.0188	.0014	
172,975	1,100	.0295	.0015	
188,700	1,200	.0320	.0017	Rested under initial load 40 hours, at the end of this time the micrometer showed an apparent set of ".0017 in a minus direction, an effect attributed to temperature changes. Micrometer reset at ".0017, in a plus direction.

No. 1691—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
204,425	1,300	.0350	.0025	
220,150	1,400	.0374	.0027	
235,875	1,500	.0395	.0029	E (1,000–1,500) =2,294,000 pounds per square inch.
.....	600	.0209	.0028	
.....	600	.0209	.0029	
251,600	1,600	.0424	.0031	
267,325	1,700	.0447	.0032	
283,050	1,800	.0478	.0035	
298,775	1,900	.0499	.0039	
314,500	2,000	.0525	.0040	E (1,500–2,000) =2,101,000 pounds per square inch.
.....	600	.0225	.0040	
.....	600	.0225	.0040	
330,225	2,100	.0547	.0040	
345,950	2,200	.0578	.0043	
361,675	2,300	.0606	.0045	
377,400	2,400	.0635	.0046	
393,125	2,500	.0665	.0050	E (2,000–2,500) =1.923,000 pounds per square inch.
.....	600	.0241	.0046	
.....	600	.0241	.0046	
.....	200	.0079	.....	
.....	400	.0164	.....	
.....	600	.0240	.....	
.....	800	.0298	.....	
.....	1,000	.0348	.....	
.....	1,200	.0396	.....	
.....	1,400	.0440	.....	
.....	1,600	.0480	.....	
.....	1,800	.0524	.....	
.....	2,000	.0566	.....	
.....	1,800	.0585	.....	
.....	1,600	.0497	.....	
.....	1,400	.0458	.....	
.....	1,200	.0419	.....	
.....	1,000	.0375	.....	
.....	800	.0324	.....	
.....	600	.0265	.....	
.....	400	.0180	.....	
.....	200	.0091	.0052	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	—.0001	.....	
.....	600	0.	.....	
.....	1,000	.0005	.....	
.....	1,500	.0015	.....	
.....	2,000	.0022	.....	
.....	1,500	.0019	.....	
.....	1,000	.0009	.....	
.....	600	.0002	.....	
.....	400	0.	0.	
At 2 diameters (24″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	.0004	.....	
.....	600	.0008	.....	
.....	1,000	.0014	.....	
.....	1,500	.0020	.....	
.....	2,000	.0026	.....	
.....	1,500	.0021	.....	
.....	1,000	.0015	.....	
.....	600	.0009	.....	
.....	400	.0004	0.	
At 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	0.	.....	
.....	600	—.0002	.....	
.....	1,000	0.	.....	
.....	1,500	.0006	.....	
.....	2,000	.0010	.....	
.....	1,500	.0006	.....	
.....	1,000	.0002	.....	
.....	600	—.0001	.....	
.....	400	—.0001	0.	
At middle of height of column.				
.....	100	0.	0.	Initial load.
.....	400	.0001	.....	
.....	600	.0004	.....	
.....	1,000	.0007	.....	
.....	1,500	.0011	.....	
.....	2,000	.0016	.....	
.....	1,500	.0012	.....	
.....	1,000	.0008	.....	
.....	600	.0005	.....	
.....	400	.0002	0.	
At 5 diameters (60″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	.0002	.....	
.....	600	.0004	.....	
.....	1,000	.0006	.....	
.....	1,500	.0010	.....	
.....	2,000	.0015	.....	
.....	1,500	.0011	.....	
.....	1,000	.0006	.....	
.....	600	.0005	.....	
.....	400	.0003	0.	
At 6 diameters (72″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	0.	.....	
.....	600	—.0001	.....	
.....	1,000	.0002	.....	
.....	1,500	.0005	.....	
.....	2,000	.0009	.....	
.....	1,500	.0006	.....	
.....	1,000	.0003	.....	
.....	600	0.	.....	
.....	400	—.0001	0.	
At 7 diameters (84″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	0.	.....	
.....	600	0.	.....	
.....	1,000	.0001	.....	
.....	1,500	.0006	.....	

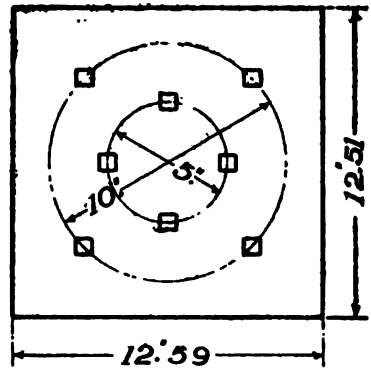
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	2,000	.0010	.....	
.....	1,500	.0006	.....	
.....	1,000	.0003	.....	
.....	600	.0001	.....	
.....	400	0.	0.	
Observations repeated on gauged length 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	400	−.0001	.....	
.....	600	−.0001	.....	
.....	1,000	0.	.....	
.....	1,500	.0005	.....	
.....	2,000	.0009	.....	
.....	1,500	.0007	.....	
.....	1,000	.0003	.....	
.....	600	0.	.....	
.....	400	0.	0.	
Measurements of lateral expansion of column discontinued.				
581,100	3,377	.....	.....	Ultimate strength.

Failed at the lower end. Opened oblique cracks in the lower two feet of the column.

No. 1688.

1:5 mixture.

Mortar column, reënforced with 8 twisted steel bars, each 95.20 inches long.



Composition, by volume: Alpha cement, 1; sand, 5.

Age, set in air 6 months 17 days.

Weight of column, total, 1,117 pounds.

Weight of mortar, 996 pounds=118.1 pounds per cubic foot.

Weight of steel bars, 121 pounds.

Height of column, 95.20 inches.

Sectional area of column, gross, 12″.51×12″.59=157.50 square inches.

Sectional area of steel bars, ″.75×″.75=□″.5625×8=4.5 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,750	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
23,625	150	.0016	0.	
31,500	200	.0035	0.	
39,375	250	.0055	.0001	
47,250	300	.0075	.0002	
55,125	350	.0096	.0005	
63,000	400	.0114	.0006	
70,875	450	.0132	.0006	
78,750	500	.0147	.0007	
86,625	550	.0165	.0009	
94,500	600	.0181	.0010	E (100-600)=1,462,000 pounds per square inch.
.....	600	.0182	.0010	

Measurements of longitudinal compression of column discontinued.

Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

Applied loads.		In guaged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0008	.....	
.....	600	.0005	0.	
At 2 diameters (24″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0004	0.	
At 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0002	.....	
.....	600	.0003	0.	
At middle of height of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0001	.....	
.....	600	.0002	0.	
At 5 diameters (60″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	0.	.....	
.....	600	.0001	0.	
At 6 diameters (72″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	.0001	.....	
.....	400	.0002	.....	
.....	600	.0003	0.	
At 7 diameters (84″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	
.....	400	.0002	.....	
.....	600	.0003	0.	

Measurements of lateral expansion of column discontinued.

Observations resumed on the longitudinal compression of the column.

Original gauged length of 50″ used, resetting the micrometer at zero.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	100	0.	0.	Initial load.
.....	600	.0173	0.	
110,250	700	.0202	.0001	
126,000	800	.0235	.0004	
141,750	900	.0265	.0006	
157,500	1,000	.0293	.0008	
.....	600	.0187	.0006	
.....	600	.0187	.0006	
173,250	1,100	.0326	.0009	
189,000	1,200	.0358	.0010	Rested under initial load 17 hours. Micrometer read zero when testing was resumed.
.....	1,200	.0358	.0004	
204,750	1,300	.0386	.0006	
220,500	1,400	.0420	.0010	
236,250	1,500	.0460	.0013	
252,000	1,600	.0497	.0017	
267,750	1,700	.0535	.0020	
283,500	1,800	.0574	.0024	
443,000	2,813	.....	.....	Ultimate strength.

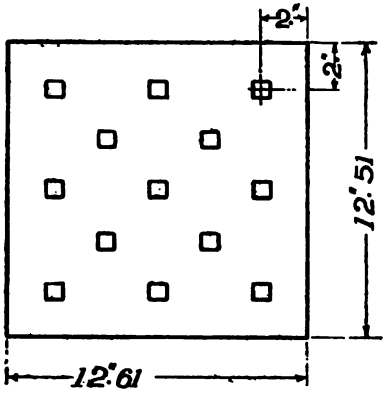
Column failed near its lower end.

Oblique lines of fracture were developed partly separating a wedge-shaped fragment 18″ long, with base at lower end of column.

No. 1689.

1:5 mixture.

Mortar column, reënforced with 13 twisted steel bars, each 95.10 inches long.



Composition, by volume: Alpha cement, 1; sand, 5.

Age, set in air, 7 months 15 days.

Weight of column, 1,191 pounds.

Weight of mortar, 994.2 pounds=120 pounds per cubic foot.

Weight of steel bars, 196.8 pounds.

Height of column, 95.10 inches.

Sectional area of column, gross, 12".51×12".61=157.75 square inches.

Sectional area of steel bars, ".75×".75=□".5625×13=7.31 square inches.

Gauged length, 50".

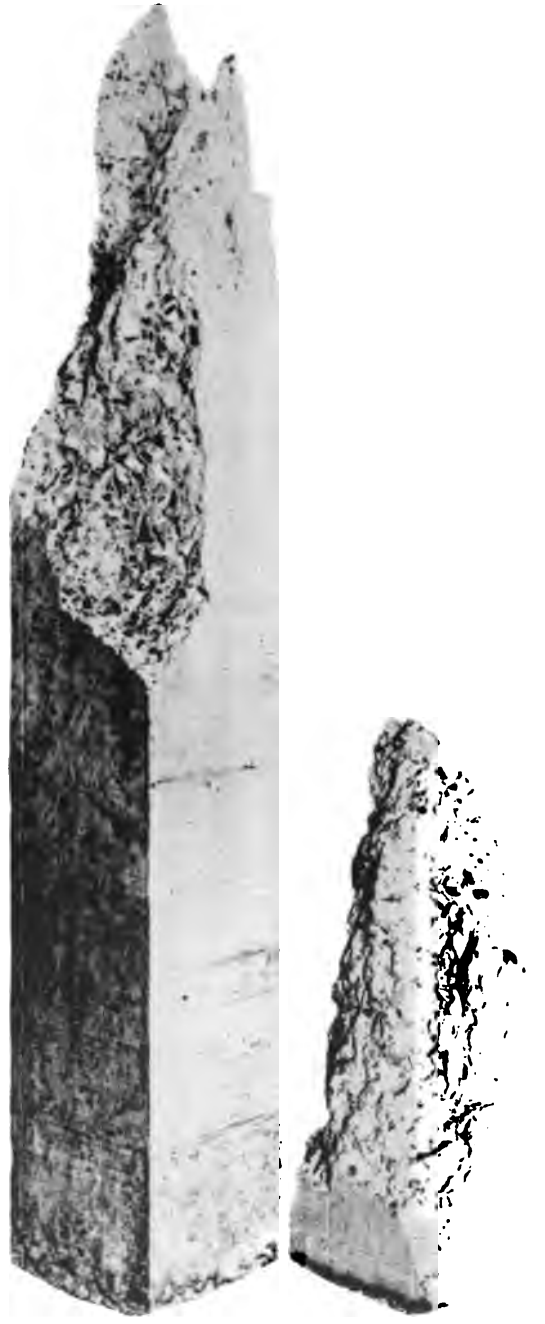
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,775	100	0.	0.	Initial load. Loaded with 14,000 pounds before testing.
23,663	150	.0010	0.	
31,550	200	.0024	.0002	
39,438	250	.0035	.0003	
47,325	300	.0050	.0004	
55,213	350	.0064	.0005	
63,100	400	.0080	.0005	
70,988	450	.0095	.0006	
78,875	500	.0109	.0007	
86,763	550	.0124	.0008	
94,650	600	.0137	.0009	E (100–600)=1,958,000 pounds per square inch.
.....	600	.0137	.0008	
102,538	650	.0150	.0008	
110,425	700	.0163	.0009	
118,313	750	.0177	.0010	
126,200	800	.0190	.0011	
134,088	850	.0203	.0011	
141,975	900	.0215	.0012	
149,863	950	.0227	.0012	
157,750	1,000	.0240	.0013	E (600–1,000) = 2,020,000 pounds per square inch.
.....	600	.0150	.0013	
.....	600	.0150	.0013	

No. 1689—Continued.

Applied load.		In guaged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
178,525	1,100	.0263	.0014	
189,300	1,200	.0289	.0014	
205,075	1,300	.0312	.0016	
220,850	1,400	.0335	.0017	
236,625	1,500	.0357	.0017	E (1,000-1,500)=2,212,000 pounds per square inch.
.....	600	.0157	.0018	
.....	600	.0157	.0018	
252,400	1,600	.0381	.0019	
268,175	1,700	.0403	.0020	
283,950	1,800	.0428	.0021	
299,725	1,900	.0451	.0021	
315,500	2,000	.0476	.0022	E (1,500-2,000)=2,198,000 pounds per square inch.
.....	600	.0165	.0022	
.....	600	.0165	.0022	
331,275	2,100	.0499	.0022	
347,050	2,200	.0526	.0024	
362,825	2,300	.0551	.0024	
378,600	2,400	.0576	.0025	
394,375	2,500	.0602	.0025	E (2,000-2,500)=2,083,000 pounds per square inch.
.....	600	.0170	.0026	
.....	600	.0170	.0026	
410,150	2,600	.0630	.0027	
425,925	2,700	.0655	.0028	
441,700	2,800	.0684	.0080	
616,000	3,905	.....	.....	Ultimate strength.

Failure began 12″ from the upper end. Longitudinal and transverse cracks opened, which extended nearly the entire length of the column.

The twisted steel bars of the outside group buckled outward at the final stage of the test. The five inner bars were bent in reverse directions at 12″ to 24″ from their upper ends.

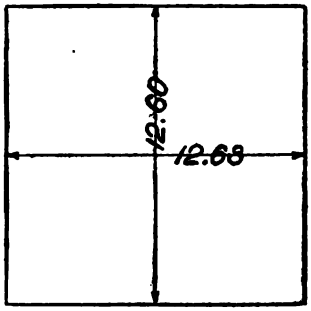


CONCRETE COLUMN NO. 1656. APPEARANCE AFTER TESTING.

HELIOTYPE CO., BOSTON.

No. 1656.

1:1:2 Mixture.
Plain column, without reënforcing metal.



Composition, by volume: Atlas cement, 1; sand, 1; trap rock (¼" to 1½"), 2.
Age, set in air, 5 months 7 days.
Weight of column, total, 1,354 pounds.
Weight of concrete, 1,354 pounds=154.7 pounds per cubic foot.
Height of column, 95.05 inches.
Sectional area of column, gross, 12".63×12".60=159.14 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,914	100	0.	0.	Initial load.
23,870	150	.0005	0.	
31,828	200	.0010	.0001	
39,785	250	.0015	.0001	
47,742	300	.0020	.0002	
55,699	350	.0024	.0002	
63,656	400	.0030	.0002	
71,613	450	.0036	.0003	
79,570	500	.0042	.0003	
87,527	550	.0048	.0004	
95,484	600	.0055	.0005	E (100—600)=5,000,000 pounds per square inch.
.....	600	.0056	.0005	
.....	600	.0056	.0005	
.....	600	.0056	.0005	
.....	600	.0056	.0005	
103,441	650	.0063	.0005	
111,398	700	.0069	.0006	
119,355	750	.0077	.0006	
127,312	800	.0083	.0007	
135,269	850	.0091	.0008	
143,226	900	.0098	.0008	
151,183	950	.0106	.0009	
159,140	1,000	.0114	.0010	
.....	1,000	.0114	.0011	
.....	1,000	.0114	.0011	
.....	1,000	.0115	.0011	
.....	1,000	.0115	.0012	

No. 1656—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
167,097	1,050	.0123	.0013	
175,054	1,100	.0130	.0013	
183,011	1,150	.0136	.0013	
190,968	1,200	.0143	.0014	
198,925	1,250	.0148	.0014	
206,882	1,300	.0156	.0015	
214,839	1,350	.0164	.0017	
222,796	1,400	.0171	.0017	
230,753	1,450	.0178	.0019	
238,710	1,500	.0185	.0020	E (1,000–1,500) = 4,098,000 pounds per square inch.
.....	1,500	.0188	.0020	
.....	1,500	.0188	.0022	
.....	1,500	.0190	.0022	
.....	1,500	.0191	.0022	
.....	600	.0080	.0022	
.....	600	.0079	.0021	
.....	600	.0079	.0021	
.....	1,000	.0133	.0021	
.....	1,000	.0133	.0021	
.....	1,000	.0132	.0021	
246,667	1,550	.0197	.0022	
254,624	1,600	.0204	.0024	
262,581	1,650	.0211	.0024	
270,538	1,700	.0219	.0025	
278,495	1,750	.0226	.0028	
286,452	1,800	.0234	.0029 .0022	Set after 1 hour's rest.
294,409	1,850	.0237	.0024	
302,366	1,900	.0244	.0027	
310,323	1,950	.0251	.0026	
318,280	2,000	.0259	.0028	E (1,500–2,000) = 3,788,000 pounds per square inch.
.....	2,000	.0260	.0028	
.....	2,000	.0262	.0029	
.....	2,000	.0264	.0030	
.....	2,000	.0265	.0034	
.....	600	.0096	.0033	
.....	600	.0094	.0033	
.....	600	.0094	.0033	
.....	1,000	.0150	.0033	
.....	1,000	.0150	.0033	
.....	1,000	.0150	.0033	
.....	1,500	.0211	.0034	
.....	1,500	.0213	.0034	
.....	1,500	.0213	.0035	
326,237	2,050	.0276	.0036	
334,194	2,100	.0284	.0037	
342,151	2,150	.0293	.0040	
350,108	2,200	.0301	.0041	
358,065	2,250	.0310	.0044	
366,022	2,300	.0318	.0046	
373,979	2,350	.0327	.0047	
381,936	2,400	.0335	.0048	
389,893	2,450	.0344	.0051	
397,850	2,500	.0353	.0054	E (2,000–2,500) = 3,676,000 pounds per square inch.
405,807	2,550	.0360	.0053	
413,764	2,600	.0369	.0056	
421,721	2,650	.0379	.0058	
429,678	2,700	.0388	.0060	
445,592	2,800	.0405	.0064	
461,506	2,900	.0423	.0067	
477,420	3,000	.0441	.0070	E (2,500–3,000) = 3,472,000 pounds per square inch.
.....	.....	.....	.0058	Set after resting 1 hour.
.....	600	.0125	.0058	
.....	600	.0127	.0058	
.....	600	.0127	.0058	
.....	1,000	.0188	.0059	
.....	1,000	.0188	.0060	
.....	1,000	.0189	.0059	
.....	1,500	.0255	.0060	
.....	1,500	.0255	.0060	
.....	1,500	.0255	.0060	
.....	2,000	.0318	.0060	
.....	2,000	.0319	.0061	

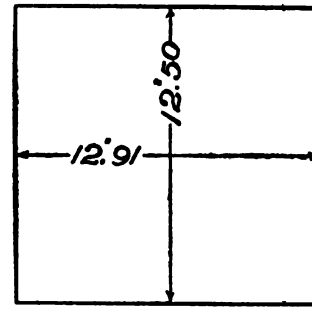
No. 1656—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	2,000	.0319	.0061	
.....	2,500	.0379	.0061	
.....	2,500	.0379	.0062	
.....	2,500	.0380	.0063 .0060	Set after resting 16 hours.
.....	2,500	.0377	.0057	
.....	2,500	.0380	.0060	
.....	3,000	.0444	.0064	
.....	3,000	.0451	.0068	
.....	3,000	.0457	.0070	
493,334	3,100	.0474	.0074	
509,248	3,200	.0492	.0079	
525,162	3,300	.0515	.0084	
541,076	3,400	.0540	.0092	
556,990	3,500	.0568	.0100	E (3,000-3,500)=2,577,000 pounds per square inch.
.....	600	.0176	.0097	
.....	600	.0175	.0096	
.....	600	.0173	.0096	
.....	1,000	.0238	.0096	
.....	1,000	.0239	.0096	
.....	1,000	.0240	.0096	
.....	1,500	.0310	.0095	
.....	1,500	.0311	.0095	
.....	1,500	.0312	.0096	
.....	2,000	.0379	.0096	
.....	2,000	.0381	.0097	
.....	2,000	.0381	.0096	
.....	2,500	.0445	.0096	
.....	2,500	.0445	.0097	
.....	2,500	.0445	.0098	
572,904	3,600	.0602	.0111	
588,818	3,700	.0639	.0124	
604,732	3,800	.0681	.0136	
620,646	3,900	.....	.....	Ultimate strength.

The maximum load was sustained momentarily, then the column suddenly failed, separating along an oblique crack in the upper half.

No. 1683.

1:2:4 Mixture.
Plain column, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock ($\frac{1}{4}$" to 1$\frac{1}{2}$"), 4.
Age, set in air, 6 months 5 days.
Weight of column, total, 1,331 pounds.
Weight of concrete, 1,331 pounds=150.2 pounds per cubic foot.
Height of column, 94.90 inches.
Sectional area of column, gross, 12".91×12".50=161.38 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,138	100	0.	0.	Initial load. Loaded with 11,500 pounds before testing.
24,207	150	.0004	0.	
32,276	200	.0010	0.	
40,345	250	.0015	0.	
48,414	300	.0020	.0001	
56,483	350	.0028	.0002	
64,552	400	.0037	.0005	
72,621	450	.0044	.0005	
80,690	500	.0052	.0006	Rested under initial load 16 hours.
88,759	550	.0064	.0010	
96,528	600	.0074	.0018	E (100-600)=4,098,000 pounds per square inch.
.....	600	.0074	.0014	
112,966	700	.0091	.0016	
129,104	800	.0110	.0019	
145,242	900	.0130	.0024	
161,380	1,000	.0150	.0026	E (600-1,000)=3,175,000 pounds per square inch.
.....	600	.0098	.0026	
.....	600	.0098	.0026	
177,518	1,100	.0171	.0030	
193,656	1,200	.0195	.0036	
209,794	1,300	.0220	.0042	
225,932	1,400	.0246	.0050	
242,070	1,500	.0276	.0060	E (1,000-1,500)=2,717,000 pounds per square inch.
.....	600	.0138	.0060	
.....	600	.0137	.0059	

Measurements of longitudinal compression of column discontinued. Observations on the lateral expansion of the column made on transverse gauged lengths, of 10″ each, established at different places along its length.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
At ⅛ diameter (8″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0005	.....	
.....	1,000	.0010	.....	
.....	1,500	.0020	.0005	
At ¼ diameter (6″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0009	.....	
.....	1,000	.0017	.....	
.....	1,500	.0029	.0005	
.....	1,500	.0035	.0009	
At ⅜ diameter (9″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0011	.....	
.....	1,000	.0021	0.	
At 1 diameter (12″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0008	.....	
.....	1,000	.0015	0.	
At 2 diameters (24″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0005	.....	
.....	1,000	.0009	.0001	
At 3 diameters (36″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0005	.....	
.....	1,000	.0008	.0002	
.....	1,000	.0008	.0002	
At 4 diameters (at middle) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0002	.....	
.....	1,000	.0005	0.	
At 5 diameters (60″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0003	.....	
.....	1,000	.0006	0.	
At 6 diameters (72″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0004	.....	
.....	1,000	.0007	.0001	
At 7 diameters (84″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0002	.....	
.....	1,000	.0005	0.	
816,000	1,958	Maximum stress applied and released to the initial load of 100 pounds per square inch, after which observations were made on the lateral expansion of the column.		
At ⅜ diameter (9″) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	600	.0020	.....	
.....	1,000	.0040	.....	
.....	1,500	.0065	.....	
.....	1,000	.0058	.....	
.....	600	.0048	.0009	
.....	200	.0010	.....	
.....	400	.0020	.....	
.....	600	.0031	.....	
.....	800	.0042	.....	
.....	1,000	.0050	.....	
.....	1,200	.0057	.....	
.....	1,400	.0064	.....	
.....	1,200	.0063	.....	
.....	1,000	.0060	.....	
.....	800	.0055	.....	
.....	600	.0050	.....	
.....	400	.0040	.....	
.....	200	.0025	.....	
At 4 diameters (at middle) from lower end of column.				
.....	100	0.	0.	Initial load.
.....	200	0.	.....	

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Lateral expansion.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	100	.0002	.....	
.....	600	.0004	.....	
.....	800	.0006	.....	
.....	1,000	.0008	.....	
.....	1,200	.0009	.....	
.....	1,400	.0010	.....	
.....	1,200	.0009	.....	
.....	1,000	.0008	.....	
.....	800	.0007	.....	
.....	600	.0005	.....	
.....	400	.0004	.....	
.....	200	.0001	0.	
Measurements of lateral expansion of column discontinued.				
321,200	1,990	.....	.....	Ultimate strength.

Opened zigzag cracks 5 inches to 30 inches from lower end of column.

The load sustained by the column gradually fell as the cracks increased.

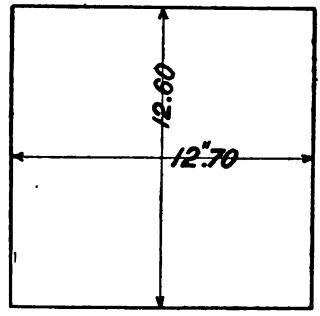
Test discontinued when the sustaining power had fallen to 200,000 pounds. Removed from the testing machine and ruptured part photographed.

CONCRETE COLUMN NO. 1683. APPEARANCE AFTER TESTING.

HELIOTYPE CO., BOSTON.

No. 1650.

1:1:2 mixture.
Plain column, without reënforcing metal.



Composition, by volume: Vulcanite cement, 1; sand, 1; pebbles ($\frac{1}{2}$" to 1$\frac{1}{2}$"), 2.
Age, set in air, 5 months 7 days.
Weight of column, total, 1,267 pounds.
Weight of concrete, 1,267 pounds = 144 pounds per cubic foot.
Height of column, 95 inches.
Sectional area of column, gross, 12".70 × 12".60 = 160.02 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,002	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
24,003	150	.0009	0.	
32,004	200	.0018	.0002	
40,005	250	.0028	.0004	
48,006	300	.0039	.0006	
56,007	350	.0050	.0009	
64,008	400	.0063	.0011	
72,009	450	.0078	.0015	
80,010	500	.0090	.0019	
88,011	550	.0102	.0020	
96,012	600	.0116	.0023	E (100–600) = 2,688,000 pounds per square inch.
.....	600	.0116	.0024	
.....	600	.0119	.0026	
.....	600	.0120	.0028	
.....	600	.0120	.0028	
.....	100	.....	.0021	Remained under initial load 16 hours.
.....	600	.0117	.0024	
.....	600	.0119	.0027	
.....	600	.0120	.0028	
.....	600	.0120	.0029	
.....	600	.0121	.0029	
.....	600	.0122	.....	
.....	400	.0091	.....	
.....	600	.0123	.....	
.....	400	.0091	.....	
.....	600	.0124	.....	
.....	400	.0091	.....	
.....	600	.0125	.....	
.....	400	.0093	.0031	
.....	400	.0090	.....	
.....	600	.0125	.....	
.....	600	.0127	.....	After sustaining load 5 minutes.

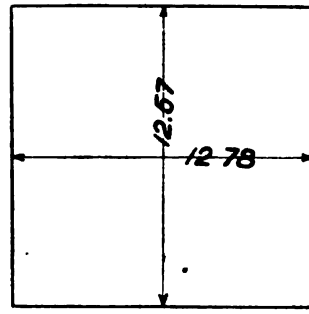
No. 1650—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	400	.0095	.....	
.....	600	.0128	.....	
.....	600	.0130	.....	After sustaining load 5 minutes.
.....	600	.0130	.....	After sustaining load 10 minutes.
.....	400	.0098	.....	
.....	600	.0130	.....	
.....	400	.0099	.0088	
.....	400	.0095	.....	
.....	600	.0130	.....	
104,013	650	.0138	.0088	
112,014	700	.0149	.0088	
120,015	750	.0160	.0040	
128,016	800	.0170	.0041	
136,017	850	.0185	.0045	
144,018	900	.0196	.0047	
152,019	950	.0209	.0048	
160,020	1,000	.0224	.0055	E (600–1,000)=2,632,000 pounds per square inch.
.....	400	.0118	.....	
.....	600	.0155	.0055	
.....	600	.0155	.0055	
.....	600	.0155	.0055	
176,022	1,100	.0249	.0061	
192,024	1,200	.0275	.0069	
208,026	1,300	.0299	.0074	
224,028	1,400	.0326	.0081	
240,030	1,500	.0355	.0089	E (1,000–1,500)=2,577,000 pounds per square inch.
.....	400	.0153	.....	
.....	600	.0195	.0090	
.....	600	.0195	.0091	
.....	600	.0196	.0091	
.....	1,000	.0271	.0092	
.....	1,000	.0274	.0093	
.....	1,000	.0277	.....	
.....	1,000	.0278	.0098	After sustaining load 5 minutes.
.....	1,000	.0277	.0097	
244,000	1,525	.....	.....	Ultimate strength.

Failed at the upper end of the column.

No. 1651.

1:2:4 Mixture.
Plain column, without reënforcing metal.



Composition, by volume: Vulcanite cement, 1; sand, 2; pebbles ($\frac{1}{4}$" to 1$\frac{1}{2}$"), 4.
Age, set in air, 5 months 6 days.
Weight of column, total, 1,280 pounds.
Weight of concrete, 1,280 pounds = 144.9 pounds per cubic foot.
Height of column, 95 inches.
Sectional area of column, gross, 12".57 × 12".78 = 160.64 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,064	100	0.	0.	Initial load. Loaded with 11,000 pounds before testing.
24,096	150	.0004	0.	
32,128	200	.0009	.0001	
40,160	250	.0019	.0008	
48,192	300	.0029	.0007	
56,224	350	.0041	.0009	
64,256	400	.0054	.0012	
72,288	450	.0069	.0018	
80,320	500	.0084	.0021	
88,352	550	.0098	.0026	
96,384	600	.0114	.0031	E (100-600) = 3,012,000 pounds per square inch.
.....	600	.0116	.0032	
.....	600	.0118	.0034	
.....	600	.0119	.0035	
.....	600	.0122	.0037	
.....	600	.0123	.....	
.....	600	.0126	.0041	After sustaining load 5 minutes.
.....	600	.0126	.....	
.....	600	.0129	.0043	Do.
.....	600	.0129	.....	
104,416	650	.0139	.0044	
112,448	700	.0150	.0046	
120,480	750	.0164	.0049	
128,512	800	.0180	.0056	
136,544	850	.0195	.0060	
144,576	900	.0211	.0068	
152,608	950	.0230	.0073	
160,640	1,000	.0249	.0081	E (600-1,000) = 2,353,000 pounds per square inch.

No. 1651—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	1,000	.0254	.....	
.....	1,000	.0264	.....	After sustaining load 5 minutes.
.....	1,000	.0267	.....	After sustaining load 10 minutes.
.....	1,000	.0287	.0122	After sustaining load 2 hours.
.....	1,000	.0287	.....	
176,704	1,100	.0308	.0123	
192,768	1,200	.0338	.0130	
208,832	1,300	.0375	.0142	
224,896	1,400	.0429	.0168	
240,960	1,500	.0498	.0205	E (1,000–1,500) = 2,000,000 pounds per square inch.
242,000	1,506	.....	.....	Ultimate strength.

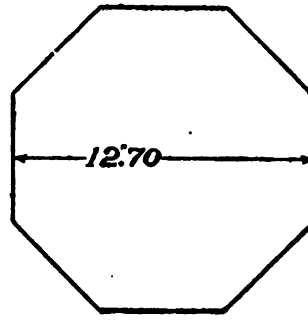
Failed near the lower end of the column. Opened irregular, oblique lines of fracture.

CONCRETE COLUMN NO. 1667. APPEARANCE AFTER TESTING.

HELIOTYPE CO., BOSTON.

No. 1667.

1 : 2 : 5 Mixture.
Plain column, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (¼″ to 1½″), 5.
Age, set in air, 3 months 8 days.
Weight of column, total, 1,089 pounds.
Weight of concrete, 1,089 pounds=148 pounds per cubic foot.
Height of column, 95.25 inches.
Diameter of column, 12.70 inches.
Sectional area, gross, 133.60 square inches.
Gauged length, 50″.

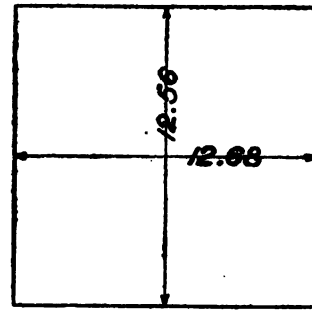
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,360	100	0.	0.	Initial load. Loaded with 15,000 pounds before testing.
20,040	150	.0008	0.	
26,720	200	.0014	0.	
32,400	250	.0021	0.	
40,080	300	.0030	.0002	
46,760	350	.0040	.0005	
53,440	400	.0050	.0007	
60,120	450	.0060	.0008	
66,800	500	.0072	.0010	
73,480	550	.0086	.0014	
80,160	600	.0100	.0018	E (100–600)3,049,000 pounds per square inch.
.....	600	.0102	.0020	
86,840	650	.0113	.0023	
93,520	700	.0127	.0027	
100,200	750	.0141	.0031	
106,880	800	.0158	.0039	
113,560	850	.0178	.0045	
120,240	900	.0198	.0054	
126,920	950	.0218	.0061	
133,600	1,000	.0242	.0077	E (600–1,000)=2,410,000 pounds per square inch.
.....	600	.0174	.0075	
.....	600	.0178	.0076	
140,280	1,050	.0270	.0090	
146,960	1,100	.....	.....	Ultimate strength.

Failed near lower end. Opened longitudinal and oblique cracks at 1 foot to 3 feet from end of column.

No. 1649.

1:3:6 Mixture.

Plain column, without reënforcing metal.



Composition, by volume: Vulcanite cement, 1; sand, 3; pebbles ($\frac{1}{2}$" to $1\frac{1}{2}$"), 6.

Age, set in air, 5 months 5 days.

Weight of column, total, 1,269 pounds.

Weight of concrete, 1,269 pounds=144.9 pounds per cubic foot.

Height of column, 95.05 inches.

Sectional area of column, gross, 12".68×12".56=159.26 square inches.

Gauged length, 50".

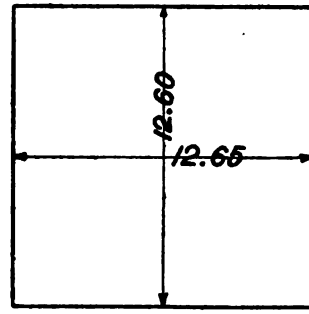
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,926	100	0.	0.	Initial load. Loaded with 8,500 pounds before testing.
23,889	150	.0023	.0014	
31,852	200	.0050	.0027	
39,815	250	.0082	.0043	
47,778	300	.0114	.0060	
55,741	350	.0151	.0081	
63,704	400	.0193	.0108	
71,667	450	.0238	.0135	
79,630	500	.0290	.0168	
87,593	550	.0350	.0208	
95,556	600	.0437	.0289	E (100-600) = 1,488,000 pounds per square inch.
103,519	650	.0567	.0360	
111,482	700	.....	.0685	Ultimate strength.

Sustained the maximum load momentarily. The load was released and set determined. Upon reloading the column irregular, oblique cracks opened along the middle of its height, which continued to develop under diminished stresses.

CONCRETE COLUMN NO. 1[illegible]. APPEARANCE AFTER TESTING.
MIDDLE PART OF ITS HEIGHT.

No. 1655.

1:3:6 Mixture.
Plain column, without reënforcing metal.



Composition, by volume: Atlas cement, 1; sand, 3; cinders, 6.
Age, set in air, 5 months 6 days.
Weight of column, total, 941 pounds.
Weight of concrete, 941 pounds=107.1 pounds per cubic foot.
Height of column, 95.30 inches.
Sectional area of column, gross, 12″.65×12″.60=159.39 square inches.
Gauged length, 50″.

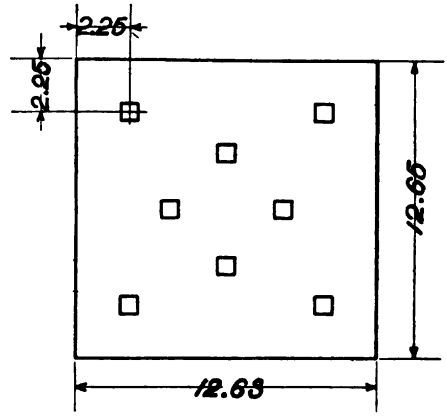
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,989	100	0.	0.	Initial load. Loaded with 14,000 pounds before testing.
23,909	150	.0022	.0004	
31,878	200	.0048	.0009	
39,848	250	.0075	.0015	
47,817	300	.0106	.0020	
55,787	350	.0134	.0026	
63,756	400	.0164	.0032	
71,726	450	.0197	.0043	
79,695	500	.0230	.0050	
87,665	550	.0266	.0060	
95,634	600	.0300	.0073 .0068	E (100-600)=1,101,000 pounds per square inch. Set after 10 minutes.
.....	600	.0306	.0075	
.....	600	.0311	.0080	
.....	600	.0315	.0084	
.....	600	.0320	.0086	
103,604	650	.0350	.0093	
111,573	700	.0386	.0104	
119,543	750	.0430	.0118	
127,512	800	.0479	.0135	
135,482	850	.0531	.0161	
143,451	900	.0596	.0186	
151,421	950	.0667	.0219	
159,390	1,000	.0765	.0278	E (600-1,000)=755,000 pounds per square inch.
.....	1,000	.0805	.0299	
.....	1,000	.0840	.0320	
167,360	1,050	.0985	.0380	
169,000	1,060	.....	.....	Ultimate strength.

Opened oblique cracks near middle of height of column.

No. 1652.

1:2:4 Mixture.

Reënforced with 8 twisted steel bars, each 94″.55 long.



Composition, by volume: Vulcanite cement, 1; sand, 2; cinders, 4.

Age, set in air, 5 months 5 days.

Weight of column, total, 1,022 pounds.

Weight of concrete, 901 pounds=106 pounds per cubic foot.

Weight of steel bars, 121 pounds.

Height of column, 94.55 inches.

Sectional area of column, gross, 12″.65×12″.63=159.77 square inches.

Sectional area of steel bars, ″.75×″.75=□″.5625×8=4.5 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,977	100	0.	0.	Initial load. Loaded with 13,000 pounds before testing.
23,966	150	.0011	0.	
31,954	200	.0023	0.	
39,943	250	.0035	.0002	
47,931	300	.0049	.0004	
55,920	350	.0064	.0005	
63,908	400	.0080	.0006	
71,897	450	.0095	.0007	
79,885	500	.0111	.0008	
87,874	550	.0128	.0010	
95,862	600	.0142	.0012	E (100-600) =1,923,000 pounds per square inch.
.....	600	.0145	.0012	
.....	600	.0145	.0013	
.....	600	.0146	.0013	
.....	600	.0146	.0013	
103,851	650	.0161	.0014	
111,839	700	.0176	.0015	
119,828	750	.0193	.0017	
127,816	800	.0210	.0018	
135,805	850	.0225	.0019	
143,793	900	.0241	.0020	
151,782	950	.0258	.0021	
159,770	1,000	.0275	.0023	E (600-1,000) =1,639,000 pounds per square inch.

No. 1652—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	1,000	.0275	.0022	
.....	1,000	.0277	.0024	
.....	1,000	.0279	.0024	
.....	1,000	.0279	.0024	
167,759	1,050	.0295	.0025	
175,747	1,100	.0310	.0028	
183,736	1,150	.0327	.0028	
191,724	1,200	.0343	.0028	
199,713	1,250	.0360	.0030	
207,701	1,300	.0376	.0030	
215,690	1,350	.0393	.0031	
223,678	1,400	.0410	.0032	
231,667	1,450	.0429	.0033	
239,655	1,500	.0445	.0034	E (1,000–1,500)=1,572,000 pounds per square inch.
.....	1,500	.0450	.0035	
.....	1,500	.0451	.0035	
.....	1,500	.0451	.0035	
.....	1,500	.0454	.0036	
247,644	1,550	.0468	.0037	
255,632	1,600	.0483	.0037	
263,621	1,650	.0499	.0037	
271,609	1,700	.0520	.0038	
279,598	1,750	.0535	.0039	
287,586	1,800	.0552	.0040	
295,575	1,850	.0569	.0041	
303,563	1,900	.0590	.0042	
311,552	1,950	.0609	.0043	
319,540	2,000	.0626	.0043	E (1,500–2,000)=1,458,000 pounds per square inch.
.....	2,000	.0628	.0045	
.....	2,000	.0633	.0045	
.....	2,000	.0635	.0047	
.....	2,000	.0639	.0046	
.....	2,000	.0641	.0048	
.....	2,000	.0642	.0046	
.....	2,000	.0643	.0047	
327,529	2,050	.0659	.0047	
335,517	2,100	.0676	.0047	
343,506	2,150	.0694	.0049	
351,494	2,200	.0714	.0050	
359,483	2,250	.0733	.0052	Rested 1 hour under initial load.
367,471	2,300	.0749	.0050	
375,460	2,350	.0778	.0052	
383,448	2,400	.0798	.0056	
391,437	2,450	.0813	.0056	
399,425	2,500	.0838	.0060	E (2,000–2,500)=1,282,000 pounds per square inch. Rested 18 hours under initial load, at the end of which the micrometer showed the set to be ".0048.
.....	200	.0074	.....	
.....	300	.0109	.....	
.....	400	.0148	.....	
.....	500	.0189	.....	
.....	600	.0227	.....	
.....	500	.0193	.....	
.....	400	.0156	.....	
.....	300	.0117	.....	
.....	200	.0081	.0064	
.....	600	.0228	.0062	
.....	600	.0228	.0058	
.....	600	.0230	.0053	
.....	600	.0230	.0054	
.....	600	.0230	.0054	
.....	1,000	.0376	.0055	
.....	1,000	.0376	.0056	
.....	1,000	.0376	.0056	
.....	1,000	.0377	.0057	
.....	1,000	.0377	.0056	
.....	1,500	.0539	.0057	
.....	1,500	.0540	.0058	
.....	1,500	.0536	.0054	
.....	1,500	.0537	.0053	
.....	1,500	.0538	.0053	

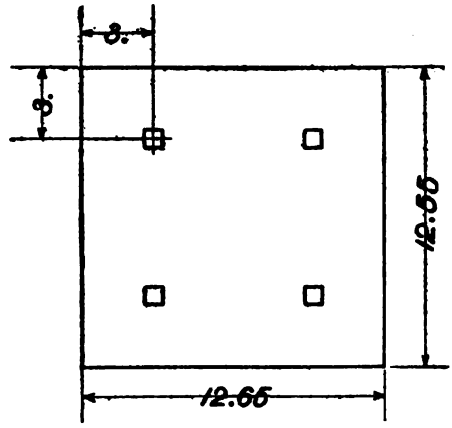
No. 1652—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	2,000	.0688	.0054	
.....	2,000	.0691	.0055	
.....	2,000	.0691	.0055	
.....	2,000	.0691	.0056	
.....	2,000	.0692	.0056	Set became ".0053 after 5 minutes.
.....	600	.0231	.0054	
.....	600	.0233	.0053	
.....	600	.0232	.0053	
.....	2,500	.0841	.0057	
407,414	2,550	.0864	.0060	
415,402	2,600	.0888	.0064	
423,391	2,650	.0912	.0069	
484,000	3,029	.....	.....	Ultimate strength.

Failed near middle of height.

No. 1653.

1:3:6 Mixture.
Reënforced with 4 twisted steel bars, each 94.50 inches long.



Composition, by volume: Atlas cement, 1; sand, 3; cinders, 6.
Age, set in air, 5 months 5 days.
Weight of column, total, 952 pounds.
Weight of concrete, 891.5 pounds=104.2 pounds per cubic foot.
Weight of steel bars, 60.5 pounds.
Height of column, 94.50 inches.
Sectional area of column, gross, 12″.55×12″.65=158.76 square inches.
Sectional area of steel bars, ″.75×″.75=□″.5625×4=2.25 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,876	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
23,814	150	.0017	.0001	
31,752	200	.0035	.0003	
39,690	250	.0055	.0006	
47,628	300	.0076	.0008	
55,566	350	.0100	.0011	
63,504	400	.0124	.0012	
71,442	450	.0146	.0016	
79,380	500	.0169	.0017	
87,318	550	.0193	.0020	
95,256	600	.0218	.0023	E (100-600) =1,282,000 pounds per square inch.
.....	600	.0220	.0025	Set ″.0030 at end of 8 hours.
.....	600	.0228	.0031	
.....	600	.0230	.0032	
.....	600	.0230	.0033	
103,194	650	.0253	.0034	
111,132	700	.0276	.0036	
119,070	750	.0300	.0038	
127,008	800	.0327	.0041	
134,946	850	.0351	.0044	
142,884	900	.0380	.0048	

No. 1653—Continued.

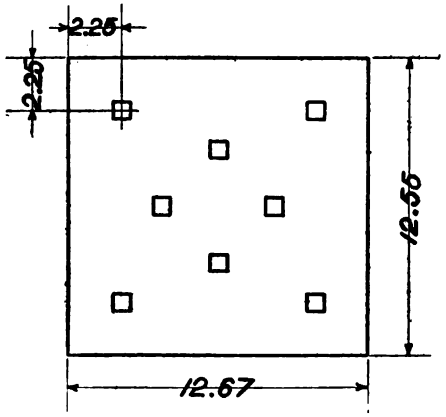
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
150,822	950	.0406	.0051	
158,760	1,000	.0444	.0054	E (600–1,000)=1,005,000 pounds per square inch.
.....	1,000	.0449	.0055	
.....	1,000	.0445	.0057	
.....	1,000	.0445	.0059	
.....	1,000	.0449	.0060 .0049	Set after resting under initial load 40 hours.
.....	1,000	.0442	.0054	
.....	1,000	.0446	.0056	
166,698	1,050	.0470	.0058	
174,636	1,100	.0493	.0059	
182,574	1,150	.0522	.0064	
190,512	1,200	.0550	.0067	
198,454	1,250	.0577	.0069	
206,388	1,300	.0606	.0071	
214,326	1,350	.0638	.0078	
222,264	1,400	.0674	.0081	
230,202	1,450	.0712	.0088	
238,140	1,500	.0746	.0093	E (1,000–1,500)=965,000 pounds per square inch.
246,078	1,550	.0780	.0099	
254,016	1,600	.0823	.0108	
261,954	1,650	.0866	.0118	Snapping sounds.
269,892	1,700	.0906	.0128	
277,830	1,750	.0951	.0140	
285,768	1,800	.1006	.0157	
.....	600	.0452	.0153	
.....	600	.0454	.0152	
.....	600	.0455	.0153	
.....	600	.0453	.0153	
.....	600	.0453	.0153	
.....	1,000	.0662	.0154	
.....	1,000	.0662	.0155	
.....	1,000	.0663	.0154	
.....	1,000	.0662	.0154	
.....	1,000	.0662	.0154	
306,700	1,932	.....	.....	Ultimate strength.

Failed near middle of height.

No. 1654.

1 : 3 : 6 Mixture.

Reënforced with 8 twisted steel bars, each 94.41 inches long.



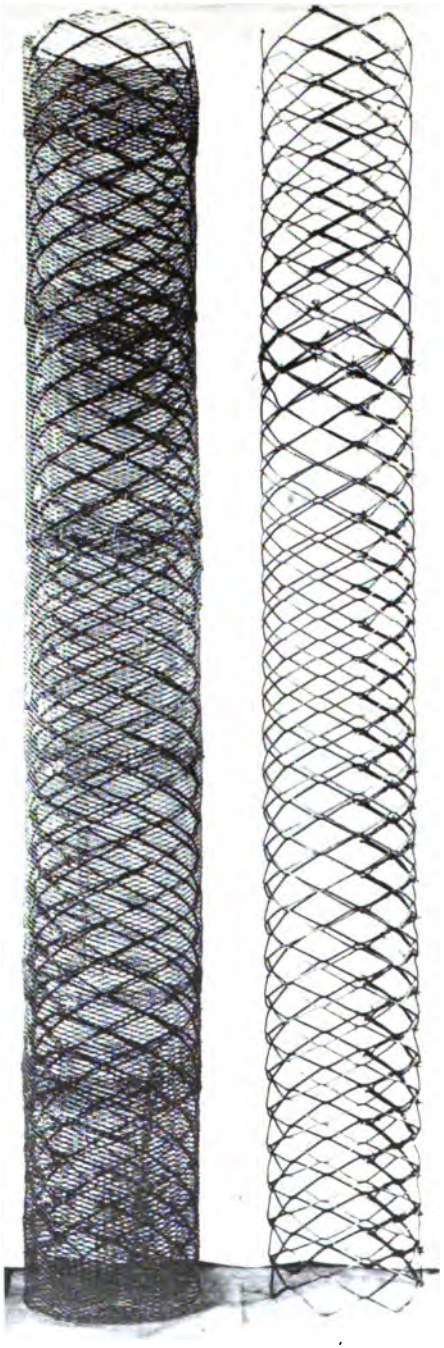
Composition, by volume: Atlas cement, 1; sand, 3; cinders, 6.
Age, set in air, 5 months 6 days.
Weight of column, total, 1,019 pounds.
Weight of concrete, 898 pounds=108.4 pounds per cubic foot.
Weight of steel bars, 121 pounds.
Height of column, 94.41 inches.
Sectional area of column, gross, 12″.67×12″.55=159.01 square inches.
Sectional area of steel bars, ″.75×″.75=□″.5625×8=4.50 square inches.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,901	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
23,852	150	.0010	0.	
31,802	200	.0019	0.	
39,753	250	.0031	0.	
47,703	300	.0044	0.	
55,654	350	.0056	.0003	
63,604	400	.0072	.0004	
71,555	450	.0090	.0007	
79,505	500	.0114	.0003	
87,456	550	.0120	.0005	
95,406	600	.0133	.0003	E (100–600)=1,928,000 pounds per square inch.
103,357	650	.0147	.0004	
111,307	700	.0162	.0005	Rested under initial load 16 hours.
119,258	750	.0181	.0009	
127,208	800	.0198	.0011	
135,159	850	.0215	.0013	
143,109	900	.0231	.0014	
151,060	950	.0247	.0016	
159,010	1,000	.0263	.0016	E (600–1,000)=1,709,000 pounds per square inch.
.....	1,000	.0271	.0022	
.....	1,000	.0272	.0022	
.....	1,000	.0274	.0023	
.....	1,000	.0274	.0024	
166,961	1,050	.0291	.0025	
174,911	1,100	.0308	.0027	
182,862	1,150	.0326	.0027	

No. 1654—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
190,812	1,200	.0346	.0029	
198,763	1,250	.0361	.0031	
206,713	1,300	.0377	.0032	
214,664	1,350	.0393	.0033	
222,614	1,400	.0411	.0033	
230,565	1,450	.0429	.0034	
238,515	1,500	.0449	.0036	E (1,000–1,500) = 1,506,000 pounds per square inch.
.....	1,500	.0450	.0038	
.....	1,500	.0452	.0038	
.....	1,500	.0455	.0038	
.....	1,500	.0456	.0038	
246,466	1,550	.0470	.0036	
254,416	1,600	.0488	.0038	
262,367	1,650	.0505	.0039	
270,317	1,700	.0521	.0039	
278,268	1,750	.0538	.0038	
286,218	1,800	.0558	.0040	
294,169	1,850	.0578	.0040	
302,119	1,900	.0596	.0041	
310,070	1,950	.0614	.0042	
318,020	2,000	.0633	.0043	E (1,500–2,000) = 1,412,000 pounds per square inch.
.....	2,000	.0637	.0043	
.....	2,000	.0640	.0044	
.....	2,000	.0645	.0044	
.....	2,000	.0645	.0045	
325,971	2,050	.0664	.0045	
333,921	2,100	.0682	.0046	
341,872	2,150	.0700	.0046	
349,822	2,200	.0721	.0046	
357,773	2,250	.0740	.0047	
365,723	2,300	.0761	.0048	
373,674	2,350	.0782	.0049	
381,624	2,400	.0807	.0051	
389,575	2,450	.0831	.0054	
397,525	2,500	.0856	.0059	E (2,000–2,500) = 1,208,000 pounds per square inch.
405,476	2,550	.0882	.0063	
413,426	2,600	.0908	.0068	
421,377	2,650	.0939	.0075	
429,327	2,700	.0971	.0085	
437,278	2,750	.1006	.0098	
445,228	2,800	.1042	.0111	
453,179	2,850	.1083	.0128	
.....	1,000	.0489	.0125	Rested under inital load ½ hour.
.....	1,000	.0483	.0124	
.....	1,000	.0485	.....	
.....	1,000	.0485	.....	
.....	1,000	.0485	.....	
.....	200	.0159	.....	
.....	300	.0198	.....	
.....	400	.0240	.....	
.....	500	.0284	.....	
.....	600	.0326	.....	
.....	700	.0368	.....	
.....	800	.0408	.....	
.....	900	.0448	.....	
.....	1,000	.0486	.....	
.....	900	.0454	.....	
.....	800	.0418	.....	
.....	700	.0379	.....	
.....	600	.0338	.....	
.....	500	.0294	.....	
.....	400	.0251	.....	
.....	300	.0208	.....	
.....	200	.0165	.0125	
.....	600	.0328	.....	
.....	1,000	.0484	.....	
.....	600	.0338	.....	
.....	600	.0334	.0126	
493,000	3,100	.....	.....	Ultimate strength.

Failed near the middle of the height of the column.



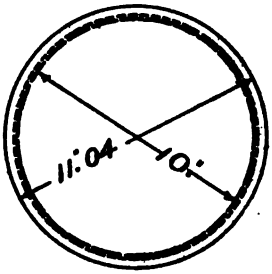
CAGES FOR RÉENFORCING CONCRETE COLUMNS. EXPANDED METAL, WITH AND WITHOUT WRAPPING OF STEEL LATHING.

No. 1665.

1:2:5 mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing.

Expanded metal, ".16 wide by ".13 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (¼" to 1½"), 5.

Surface plastered with 1:2 mortar.

Age, set in air, 3 months 11 days.

Weight of column, total, 765 pounds.

Weight of concrete, 731 pounds=140.6 pounds per cubic foot.

Weight of expanded metal and lathing, 34 pounds.

Height of column, 95.15 inches.

Diameter of column, 11.04 inches; sectional area, gross, 95.72 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
9,572	100	0.	0.	Initial load. Loaded with 5,000 pounds before testing.
14,358	150	.0010	.0001	
19,144	200	.0021	.0004	
23,930	250	.0030	.0006	
28,716	300	.0043	.0008	
33,502	350	.0055	.0012	
38,288	400	.0069	.0015	
43,074	450	.0081	.0018	
47,860	500	.0095	.0022	
52,646	550	.0109	.0025	
57,432	600	.0125	.0030	E (100-600)=2,682,000 pounds per square inch.
.....	600	.0127	.0031	
62,218	650	.0139	.0033	
67,004	700	.0155	.0040	
71,790	750	.0172	.0046	
76,576	800	.0186	.0050	
81,362	850	.0201	.0054	
86,148	900	.0222	.0065	
90,934	950	.0239	.0071	
95,720	1,000	.0254	.0076	E (600-1,000) = 2,410,000 pounds per square inch.
.....	600	.0179	.0077	
.....	600	.0174	.0077	

No. 1665—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
100,506	1,050	.0271	.0081	
105,292	1,100	.0291	.0090	
110,078	1,150	.0814	.0100	
114,864	1,200	.0835	.0109	
119,650	1,250	.0358	.0120	
.....	600	.0225	.0117	
.....	600	.0224	.0117	
124,436	1,300	.0878	.....	
129,222	1,350	.0400	.....	
134,008	1,400	.0421	.....	
138,794	1,450	.0451	.....	
143,580	1,500	.0480	.....	
148,366	1,550	.0509	.....	
153,152	1,600	.0539	.....	
157,988	1,650	.0600	.0242	
174,000	1,820	.....	.....	Ultimate strength.

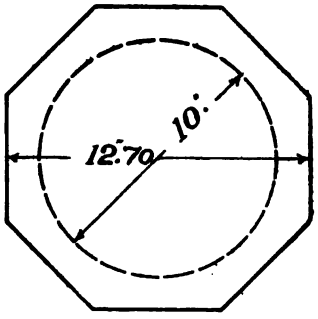
Column failed at the upper end.

No. 1666.

1:2:5 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, without steel lathing.

Expanded metal, ".16 wide by ".13 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (¼" to 1½"), 5.

Age, set in air, 4 months.

Weight of column, total, 1,099 pounds.

Weight of concrete, 1,080 pounds=146.3 pounds per cubic foot.

Weight of expanded metal, 19 pounds.

Height of column, 95 inches.

Diameter of column, 12.70 inches; sectional area, gross, 133.60 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,360	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
20,040	150	.0007	0.	
26,720	200	.0015	.0001	
33,400	250	.0024	.0003	
40,080	300	.0034	.0006	
46,760	350	.0044	.0007	
53,440	400	.0057	.0009	
60,120	450	.0068	.0013	
66,800	500	.0080	.0015	
73,480	550	.0093	.0020	
80,160	600	.0108	.0024	E (100–600)=2,976,000 pounds per square inch.
.....	600	.0112	.0028	
86,840	650	.0121	.0028	
93,520	700	.0139	.0034	
100,200	750	.0155	.0041	
106,880	800	.0175	.0051	
113,560	850	.0198	.0057	
120,240	900	.0221	.0070	
126,920	950	.0245	.0083	
133,600	1,000	.0275	.0097	E (600–1,000)=2,126,000 pounds per square inch.
.....	600	.0208	.0099	
.....	600	.0202	.0099	

No. 1666—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
140,280	1,050	.0305	.0116	
146,960	1,100	.0352	.0142	
153,640	1,150	.0408	.0173	
160,320	1,200	.0469	.0216	
167,000	1,250	.0585	.0251	
.....	600	.0390	.0254	
.....	600	.0391	.0254	
173,680	1,300	.0643	.0327	
180,360	1,350	.0780	.0438	
187,040	1,400	.1150	.0745	Ultimate strength.

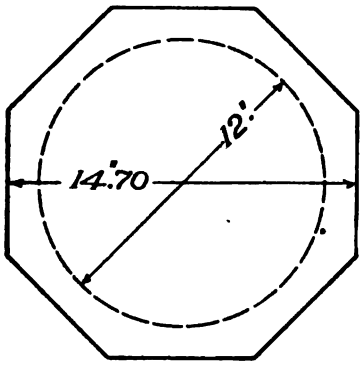
Column failed at middle of its length; opened longitudinal and oblique cracks.

No. 1668.

1:2:5 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, without steel lathing.

Expanded metal, ".16 wide by ".13 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (¼" to 1½"), 5.

Age, set in air, 3 months 8 days.

Weight of column, total, 1,495 pounds.

Weight of concrete, 1,474.5 pounds=148.9 pounds per cubic foot.

Weight of expanded metal, 20.5 pounds.

Height of column, 96.14 inches.

Diameter of column, 14.70 inches: sectional area, gross, 178.75 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
17,875	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
26,813	150	.0008	0.	
35,750	200	.0015	.0008	
44,688	250	.0022	.0005	
53,625	300	.0033	.0006	
62,563	350	.0044	.0009	
71,500	400	.0054	.0010	
80,438	450	.0064	.0013	
89,375	500	.0077	.0017	
98,313	550	.0088	.0020	
107,250	600	.0100	.0028	E (100–600)=3,247,000 pounds per square inch.
.....	600	.0102	.0026	
116,188	650	.0113	.0029	
125,125	700	.0128	.0032	
134,063	750	.0140	.0036	
143,000	800	.0155	.0040	
151,988	850	.0170	.0046	
160,875	900	.0184	.0051	
169,813	950	.0200	.0058	
178,750	1,000	.0224	.0069	E (600–1,000)=2,532,000 pounds per square inch.

No. 1668—Continued.

Applied load.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0158	.0069	
.....	600	.0157	.0069	
187,688	1,050	.0241	.0075	
196,625	1,100	.0262	.0086	
205,563	1,150	.0288	.0097	
214,500	1,200	.0320	.0112	
223,438	1,250	.0354	.0130	
.....	600	.0237	.0131	
.....	600	.0235	.0131	
232,375	1,300	.0405	.0159	
241,313	1,350	.0458	.0192	
250,250	1,400	.0582	.0242	
259,188	1,450	.0660	.0862	Ultimate strength.

Failed at a place about 2 feet from lower end; opened longitudinal and oblique cracks.

CONCRETE COLUMN NO. 1568. APPEARANCE AFTER TESTING.

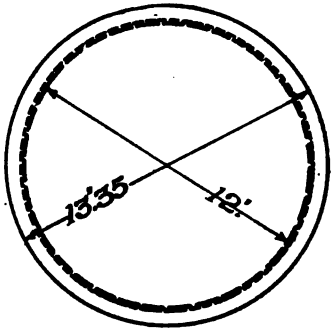
HELIOTYPE CO., BOSTON

No. 1669.

1: 2: 5 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped with steel lathing.

Expanded metal, ".24 wide by ".13 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (¼" to 1½"), 5.

Surface plastered with 1:2 mortar.

Age, set in air, 3 months.

Weight of column, total, 1,174 pounds.

Weight of concrete, 1,133 pounds = 147.7 pounds per cubic foot.

Weight of expanded metal and lathing, 41 pounds.

Height of column, 95.70 inches.

Diameter of column, 13.35 inches; sectional area, gross, 139.98 square inches.

Gauged length, 50".

Applied loads.		In gauged lengths.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,998	100	0.	0.	Initial load. Loaded with 11,000 pounds before testing.
20,997	150	.0010	.0004	
27,996	200	.0024	.0008	
34,995	250	.0036	.0013	
41,994	300	.0052	.0019	
48,993	350	.0068	.0023	
55,992	400	.0090	.0033	
62,991	450	.0109	.0040	
69,990	500	.0132	.0051	
76,989	550	.0159	.0064	
83,988	600	.0185	.0080	E (100-600) = 2,381,000 pounds per square inch.
.....	600	.0197	.0089	
90,987	650	.0219	.0097	
97,986	700	.0249	.0115	
104,985	750	.0289	.0136	
111,984	800	.0327	.0156	
118,983	850	.0380	.0189	
125,982	900	.0434	.0224	
132,981	950	.0491	.0268	
139,980	1,000	.0550	.0300	E (600-1,000) = 1,879,000 pounds per square inch.
.....	600	.0450	.0302	
.....	600	.0451	.0302	

No. 1669—Continued.

Applied loads.		In gauged lengths.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
146,979	1,050	.0612	.0339	
153,978	1,100	.0690	.0392	
160,977	1,150	.0761	.0440	
167,976	1,200	.0847	.0500	
174,975	1,250	.0925	.0550	
.....	600	.0738	.0553	
.....	600	.0734	.0550	
181,974	1,300	.1006	.0615	
188,973	1,350	.1125	.0696	
195,972	1,400	.1220	.0766	
202,971	1,450	.1338	.0854	
209,970	1,500	.1460	.0943	E (1,000–1,500)=936,000 pounds per square inch.
.....	600	.1163	.0942	
.....	600	.1158	.0942	
.....	.....	.....	.0930	Set after 1 hour.
.....	200	.0961	.....	
.....	300	.1008	.....	
.....	400	.1057	.....	
.....	500	.1104	.....	
.....	600	.1146	.....	
.....	500	.1123	.....	
.....	400	.1093	.....	
.....	300	.1054	.....	
.....	200	.1001	.0941	
216,969	1,550	.1605	.1058	
223,968	1,600	.1785	.1200	Longitudinal cracks at joints of lathing.
230,967	1,650	.1952	.1329	
237,966	1,700	.2193	.1555	
244,965	1,750	.2575	.1864	
.....	600	.2127	.1860	
.....	600	.2126	.1858	
.....	200	.1896	.....	
.....	400	.2014	.....	
.....	600	.2122	.....	
.....	800	.2228	.....	
.....	1,000	.2317	.....	
.....	800	.2273	.....	
.....	600	.2211	.....	
.....	400	.2126	.....	
.....	200	.1984	.1892	
.....	600	.2152	.1886	
251,964	1,800	.....	.....	Ultimate strength.

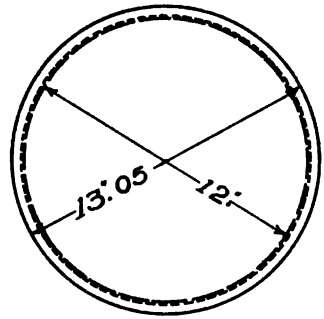
The column gradually shortened as its sustaining power was reduced. When the load had fallen to 220,000 pounds the total height of the column was 94″.90. The test was then discontinued. The concrete at middle of height of column was disintegrated, cement and loose pebbles falling out when the lathing was removed.

No. 1663.

1:2:5 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing.

Expanded metal, ".23 wide by ".12 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (¼" to 1¼"), 5.

Surface plastered with 1:2 mortar.

Age, set in air, 1 month 22 days.

Weight of column, total, 1,152 pounds.

Weight of concrete, 1,111 pounds = 150.1 pounds per cubic foot.

Weight expanded metal and lathing, 41 pounds.

Height of column, 96.65 inches.

Diameter of column, 13.05 inches; sectional area, gross, 133.76 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,376	100	0.	0	Initial load. Loaded with 10,000 pounds before testing.
20,064	150	.0010	.0002	
26,752	200	.0019	.0004	
33,440	250	.0028	.0005	
40,128	300	.0037	.0006	
46,816	350	.0045	.0008	
53,504	400	.0055	.0010	
60,192	450	.0064	.0011	
66,880	500	.0076	.0013	
73,568	550	.0086	.0015	
80,256	600	.0097	.0018	E (100–600) = 3,086,000 pounds per square inch.
.....	600	.0100	.0019	
86,944	650	.0110	.0022	
93,632	700	.0120	.0025	
100,320	750	.0130	.0028	
107,008	800	.0141	.0031	
113,696	850	.0164	.0045	Rested ½ hour. Change in temperature of room.
120,384	900	.0173	.0047	
127,072	950	.0188	.0048	
133,760	1,000	.0198	.0051	E (600–1,000) = 3,030,000 pounds per square inch.
.....	600	.0136	.0052	
.....	600	.0139	.0052	

No. 1663—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
140,448	1,050	.0210	.0053	
147,136	1,100	.0221	.0059	
153,824	1,150	.0238	.0066	
160,512	1,200	.0252	.0070	
167,200	1,250	.0269	.0075	
.....	600	.0164	.0075	
.....	600	.0164	.0075	
173,888	1,300	.0280	.0078	
180,576	1,350	.0297	.0084	
187,264	1,400	.0317	.0091	
193,952	1,450	.0337	.0099	
200,640	1,500	.0355	.0106	E (1,000–1,500)=2,451,000 pounds per square inch.
.....	600	.0202	.0106	
.....	600	.0197	.0103	
207,328	1,550	.0368	.0111	
214,016	1,600	.0388	.0120	
220,704	1,650	.0406	.0129	
227,392	1,700	.0425	.0136	
234,080	1,750	.0449	.0149	
.....	600	.0251	.0148	
.....	600	.0250	.0147	
240,768	1,800	.0471	.0161	
247,456	1,850	.0497	.0169	
254,144	1,900	.0525	.0181	
260,832	1,950	.0546	.0191	
267,520	2,000	.0580	.0208	E (1,500–2,000)=2,033,000 pounds per square inch.
.....	600	.0319	.0208	
.....	600	.0317	.0208	
274,208	2,050	.0611	.0224	
280,896	2,100	.0648	.0247	Longitudinal cracks in plastering.
287,584	2,150	.0689	.0265	
334,000	2,497	.....	.....	Ultimate strength.

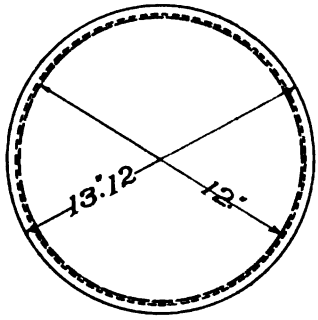
Plastering flaked off and column yielded near the lower end, expanding the metal cage.

No. 1664.

1:2:5 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing.

Expanded metal, ".31 wide by ".13 thick; lathing ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (½" to 1½"), 5.

Surface plastered, with 1:2 mortar.

Age, set in air, 1 month 23 days.

Weight of column, total, 1,133 pounds.

Weight of concrete, 1,083 pounds=146.0 pounds per cubic foot.

Weight of expanded metal and lathing, 50 pounds.

Height of column, 96.20 inches.

Diameter of column. 13.12 inches; sectional area, gross, 135.19 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,519	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
20,279	150	.0012	.0004	
27,038	200	.0020	.0006	
33,798	250	.0029	.0008	
40,557	300	.0039	.0010	
47,317	350	.0048	.0012	
54,076	400	.0059	.0014	
60,836	450	.0070	.0017	
67,595	500	.0079	.0019	
74,355	550	.0089	.0020	
81,114	600	.0100	.0023	E (100–600)=3,247,000 pounds per square inch.
.....	600	.0102	.0024	
87,874	650	.0111	.0026	
94,633	700	.0123	.0029	
101,393	750	.0136	.0032	
108,152	800	.0150	.0037	
114,912	850	.0164	.0041	
121,671	900	.0180	.0047	
128,431	950	.0193	.0052	
135,190	1,000	.0207	.0057	E (600–1,000)=2,740,000 pounds per square inch.
.....	600	.0148	.0058	
.....	600	.0144	.0057	

No. 1664—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
141,950	1,050	.0225	.0064	
148,709	1,100	.0244	.0072	
155,469	1,150	.0264	.0080	
162,228	1,200	.0284	.0087	
168,988	1,250	.0304	.0094	
.....	600	.0198	.0094	
.....	600	.0190	.0098	
175,747	1,300	.0328	.0107	
182,507	1,350	.0348	.0116	
189,266	1,400	.0374	.0127	
196,026	1,450	.0399	.0138	
202,785	1,500	.0430	.0154	E (1,000–1,500)=1,984,000 pounds per square inch.
.....	600	.0263	.0155	
.....	600	.0263	.0155	
209,545	1,550	.0449	.0164	
216,304	1,600	.0479	.0177	
223,064	1,650	.0510	.0194	Plastering cracked near lower end of column.
264,000	1,953	.....	.....	Ultimate strength.

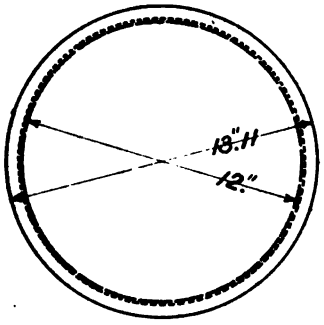
Column failed 15 inches from the lower end. Cage expanded locally.

No. 1642.

1 : 3 : 6 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing.

Expanded metal, ".23 wide by ".13 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock ($\frac{1}{2}$" to $1\frac{1}{2}$"), 6.

Surface plastered with 1 : 2 cement mortar.

Age, set in air, 2 months 2 days.

Weight of column, total, 1,071 pounds.

Weight of concrete, 1,030 pounds=138.5 pounds per cubic foot.

Weight of expanded metal and lathing, 41 pounds.

Height of column, 95.20 inches.

Diameter of column, 13.11 inches; sectional area, gross, 134.99 square inches.

Gauged length, 50".

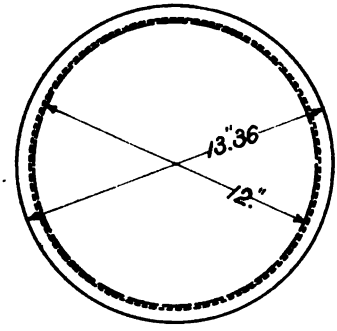
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,499	100	0.	0.	Initial load. Loaded with 13,499 pounds before testing.
20,248	150	.0015	.....	
26,998	200	.0030	.0010	
33,747	250	.0047	.....	
40,497	300	.0069	.0024	
47,246	350	.0086	.....	
53,996	400	.0110	.0039	
60,745	450	.0135	.....	
67,495	500	.0159	.0061	
74,244	550	.0191	.....	
80,994	600	.0217	.0088	E (100–600) =1,988,000 pounds per square inch.
87,743	650	.0249	.....	
94,493	700	.0286	.0124	
101,242	750	.0331	.....	
107,992	800	.0365	.0167	
114,741	850	.0406	.....	
121,491	900	.0439	.0208	
128,240	950	.0500	.....	
134,990	1,000	.0588	.0261	E (600–1,000) =1,351,000 pounds per square inch.
141,739	1,050	.0607	.....	
148,489	1,100	.0656	.0333	
155,238	1,150	.0722	.....	
161,988	1,200	.0784	.0418	
168,737	1,250	.0876	.....	
175,487	1,300	.0985	.0521	
182,236	1,350	.1055	.....	Plastering cracked circumferentially, 3 feet from upper end.
188,986	1,400	.1129	.0654	
233,000	1,730	.....	.....	Ultimate strength.

No. 1641.

1:3:6 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing.

Expanded metal, ".31 wide by ".13 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 3; pebbles (½" to 1½"), 6.

Surface plastered with 1:2 cement mortar.

Age, set in air, 2 months 2 days.

Weight of column, total, 1,084 pounds.

Weight of concrete, 1,034 pounds=142.1 pounds per cubic foot.

Weight of expanded metal and lathing, 50 pounds.

Height of column, 94.87 inches.

Diameter of column, 13.36 inches; sectional area, gross, 140.18 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,018	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
21,027	150	.0012	.....	
28,036	200	.0026	.0006	
35,045	250	.0044	.....	
42,054	300	.0068	.0022	
49,063	350	.0084	.....	
56,072	400	.0109	.0043	
63,081	450	.0135	.....	
70,090	500	.0161	.0070	
77,099	550	.0189	.....	
84,108	600	.0219	.0100	E (100-600) =2,101,000 pounds per square inch.
91,117	650	.0250	.....	
98,126	700	.0284	.0137	
105,135	750	.0319	.....	
112,144	800	.0349	.0168	
119,153	850	.0390	.....	
126,162	900	.0426	.0211	
133,171	950	.0481	.....	
140,180	1,000	.0505	.0253	E (600-1,000) =1,504,000 pounds per square inch.
147,189	1,050	.0560	.....	
154,198	1,100	.0592	.0302	
161,207	1,150	.0664	.....	
168,216	1,200	.0697	.0361	
175,225	1,250	.0762	.....	
182,234	1,300	.0800	.0421	
189,243	1,350	.0880	.....	
196,252	1,400	.0921	.0498	
202,000	.....	.....	.....	Plastering flaked off.
244,000	1,740	.....	.....	Ultimate strength.

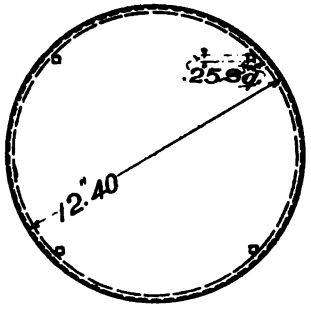
Column failed near its upper end. Oblique line of fracture.

No. 1660.

1:2:5 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing; also with 4 steel bars, each 94.20 inches long.

Expanded metal, ".16 wide by ".13 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (¼" to 1½"), 5.

Surface not plastered.

Age, set in air, 1 month 18 days.

Weight of column, total, 970 pounds.

Weight of concrete, 930.5 pounds=143.2 pounds per cubic foot.

Weight of expanded metal and lathing, 32.5 pounds.

Weight of steel bars, 7 pounds.

Height of column, 94.20 inches.

Diameter of column, 12.40 inches; sectional area, gross, 120.76 square inches.

Sectional area of steel bars, ".25×".25=□".0625×4=".25 square inch.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,076	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
18,114	150	.0007	0.	
24,152	200	.0019	.0002	
30,190	250	.0031	.0008	
36,228	300	.0047	.0013	
42,266	350	.0064	.0018	
48,304	400	.0081	.0023	
54,342	450	.0101	.0031	
60,380	500	.0124	.0040	
66,418	550	.0144	.0049	
72,456	600	.0168	.0058	E (100-600)=2,273,000 pounds per square inch.
			.0065	Set after resting 30 minutes.
.....	600	.0172	.0061	
.....	600	.0177	.0066	
78,494	650	.0195	.0071	
84,532	700	.0224	.0085	
90,570	750	.0258	.0101	
96,608	800	.0294	.0121	
102,646	850	.0329	.0187	
108,684	900	.0375	.0160	

No. 1660—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
114,722	950	.0428	.0186	
120,760	1,000	.0471	.0206	E (600–1,000) = 1,290,000 pounds per square inch.
.....	600	.0375	.0206	
.....	600	.0375	.0206	
.....	600	.0376	.0207	
126,798	1,050	.0520	.0228	
132,836	1,100	.0580	.0261	
138,874	1,150	.0646	.0297	
144,912	1,200	.0718	.0343	
150,950	1,250	.0784	.0385	
.....	600	.0601	.0382	
.....	600	.0601	.0384	
.....	600	.0601	.0385	
156,988	1,300	.0881	.0458	
163,026	1,350	.0966	.0519	
169,064	1,400	.1063	.0617	
175,102	1,450	.1171	.0679	
181,140	1,500	.1269	.0755	E (1,000–1,500) = 1,004,000 pounds per square inch.
.....	600	.0986	.0750	
.....	600	.0988	.0749	
.....	600	.0988	.0750	
187,178	1,550	.1385	.0845	
193,216	1,600	.1520	.0949	
199,254	1,650	.1640	.1043	
205,292	1,700	.1800	.1173	
211,330	1,750	.1956	.1310	
.....	600	.1565	.1305	
.....	600	.1569	.1305	
.....	600	.1569	.1305	
217,368	1,800	.2226	.1535	
223,406	1,850	.2505	.1803	
229,444	1,900	.2985	.2254	Ultimate strength.
.....	600	.2525	.2252	
.....	600	.2525	.2255	
.....	600	.2527	.2256	

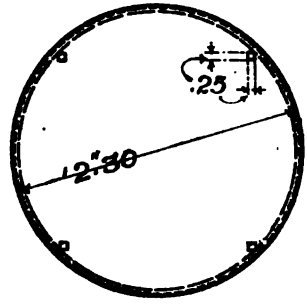
Failure occurred about 3 feet from the lower end of the column, upon reapplication of higher stresses.

No. 1662.

1:3:6 Mixture.

Reënforced with cage of 3-inch expanded metal, wrapped in steel lathing; also with 4 steel bars, each 95 inches long.

Expanded metal, ".16 wide by ".13 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 3; pebbles (½" to 1½"), 6.

Surface not plastered.

Age, set in air, 1 month 22 days.

Weight of column, total, 981 pounds.

Weight of concrete, 940 pounds=145.7 pounds per cubic foot.

Weight of expanded metal and lathing, 34 pounds.

Weight of steel bars, 7 pounds.

Height of column, 95 inches.

Diameter of column, 12.30 inches; sectional area, gross, 118.82 square inches.

Sectional area of steel bars, ".25×".25=□".0625×4=".25 square inch.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,882	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
17,823	150	.0012	.0004	
23,764	200	.0025	.0007	
29,705	250	.0040	.0010	
35,646	300	.0054	.0015	
41,587	350	.0073	.0022	
47,528	400	.0091	.0027	
53,469	450	.0110	.0035	
59,410	500	.0132	.0043	
65,351	550	.0150	.0051	
71,292	600	.0179	.0064	E (100-600)=2,174,000 pounds per square inch.
.....	600	.0184	.0068	
.....	600	.0188	.0071	
77,233	650	.0208	.0077	
83,174	700	.0229	.0088	
89,115	750	.0260	.0103	
95,056	800	.0298	.0120	
100,997	850	.0337	.0141	
106,938	900	.0385	.0165	
112,879	950	.0434	.0191	
118,820	1,000	.0479	.0214	E (600-1,000)=1,250,000 pounds per square inch.

No. 1662—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0379	.0218	
.....	600	.0379	.0216	
124,761	1,050	.0588	.0245	
130,702	1,100	.0600	.0281	
136,643	1,150	.0659	.0320	
142,584	1,200	.0710	.0340	
148,525	1,250	.0789	.0396	
.....	600	.0602	.0398	Rested ½ hour.
.....	600	.0592	.0393	
.....	600	.0590	.0392	
154,466	1,300	.0865	.0450	
160,407	1,350	.0965	.0519	
166,348	1,400	.1067	.0591	
172,289	1,450	.1169	.0664	
178,230	1,500	.1289	.0760	E (1,000-1,500)=984,000 pounds per square inch.
.....	600	.0994	.0761	
.....	600	.0991	.0760	
184,171	1,550	.1410	.0850	
190,112	1,600	.1585	.0991	
196,053	1,650	.1790	.....	Micrometer disturbed. Reset at zero under initial load.
.....	600	.0260	.0005	
.....	600	.0260	.0007	
198,000	1,666	.....	.....	Ultimate strength.

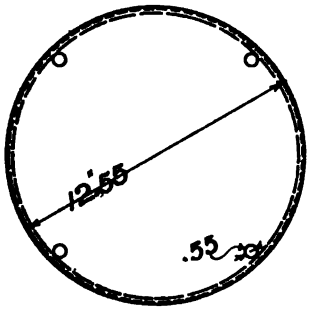
Column failed about 2′ 9″ from lower end.

No. 1659.

1 : 2 : 5 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing; also with 4 steel bars, each 94.20 inches long.

Expanded metal, ".31 wide by ".13 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles (¼" to 1½"), 5.

Surface not plastered.

Age, set in air, 1 month 27 days.

Weight of column, total, 1,048 pounds.

Weight of concrete, 972.5 pounds=147.6 pounds per cubic foot.

Weight of expanded metal and lathing, 50 pounds.

Weight of steel bars, 25.5 pounds.

Height of column, 94.20 inches.

Diameter of column, 12.55 inches; sectional area, gross, 123.70 square inches.

Sectional area of steel bars, ".55 diam.=□ ".2375×4=.95 square inch.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,370	100	0.	0.	Initial load. Loaded with 11,000 pounds before testing.
18,555	150	.0010	.0001	
24,740	200	.0021	.0002	
30,925	250	.0034	.0006	
37,110	300	.0048	.0008	
43,295	350	.0060	.0013	
49,480	400	.0071	.0019	
55,665	450	.0086	.0024	
61,850	500	.0101	.0028	
68,035	550	.0120	.0037	
74,220	600	.0131	.0038	E (100–600)=2,688,000 pounds per square inch.
80,405	650	.0145	.0040	
86,590	700	.0161	.0043	
92,775	750	.0181	.0049	
98,960	800	.0200	.0055	
105,145	850	.0219	.0060	
111,330	900	.0241	.0065	
117,515	950	.0262	.0071	
123,700	1,000	.0283	.0077	E (600–1,000)=1,770,000 pounds per square inch.

No. 1659—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0205	.0077	
.....	600	.0207	.0078	
.....	600	.0207	.0077	
129,885	1,050	.0310	.0084	
136,070	1,100	.0338	.0090	
142,255	1,150	.0368	.0098	
148,440	1,200	.0398	.0108 .0098	Set after resting 16 hours.
154,625	1,250	.0438	.0120	
.....	600	.0296	.0121	
.....	600	.0296	.0123	
.....	600	.0296	.0123	
160,810	1,300	.0482	.0137	
166,995	1,350	.0520	.0151	
173,180	1,400	.0567	.0179	
179,365	1,450	.0611	.0201	
185,550	1,500	.0667	.0238	E (1,000–1,500)=1,096,000 pounds per square inch.
.....	600	.0445	.0238	
.....	600	.0444	.0233	
.....	600	.0444	.0234	
191,735	1,550	.0726	.0268	
197,920	1,600	.0791	.0313	
204,105	1,650	.0865	.0366	
210,290	1,700	.0928	.0414	
216,475	1,750	.0994	.0469	
.....	600	.0691	.0470	
.....	600	.0690	.0470	
.....	600	.0687	.0470	
222,660	1,800	.1095	.0549	
228,845	1,850	.1195	.0634	
235,030	1,900	.1298	.0719	
241,215	1,950	.1421	.0826	
247,400	2,000	.1535	.0927	E (1,500–2,000)=1,437,000 pounds per square inch.
.....	600	.1135	.0922	
.....	600	.1129	.0923	
.....	600	.1128	.0922	
.....	200	.0960	.....	
.....	400	.1048	.....	
.....	600	.1124	.....	
.....	800	.1195	.....	
.....	1,000	.1264	.....	
.....	1,200	.1328	.....	
.....	1,000	.1294	.....	
.....	800	.1249	.....	
.....	600	.1190	.....	
.....	400	.1112	.....	
.....	200	.1000	.0980	
285,000	2,304	.....	.....	Ultimate strength.

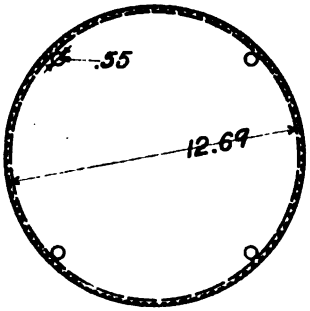
Failure occurred about 2 feet from the lower end of the column.

No. 1657.

1:3:6 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing; also with 4 steel bars, each 95".80 long.

Expanded metal, ".31 wide by ".13 thick; lathing, ".024 thick



Composition, by volume: Alpha cement, 1; sand, 3; pebbles ($\frac{1}{4}$" to $1\frac{1}{2}$"), 6.

Surface not plastered.

Age, set in air, 1 month 3 days.

Weight of column, total, 1,038 pounds.

Weight of concrete, 962 pounds = 140.2 pounds per cubic foot.

Weight of expanded metal and lathing, 50 pounds.

Weight of steel bars, 26 pounds.

Height of column, 95.80 inches.

Diameter of column, 12.69 inches; sectional area, gross, 126.48 square inches.

Sectional area of steel bars, ".55 diam. = □".2375 × 4 = .95 square inch.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,648	100	0.	0.	Initial load. Loaded with 17,000 pounds before testing.
18,972	150	.0016	.0004	
25,296	200	.0035	.0010	
31,620	250	.0055	.0016	
37,944	300	.0076	.0023	
44,268	350	.0097	.0029	
50,592	400	.0120	.0035	
56,916	450	.0143	.0043	
63,240	500	.0169	.0050	
69,564	550	.0198	.0061	
75,888	600	.0228	.0071	E (100–600) = 1,592,000 pounds per square inch.
82,212	650	.0260	.0083	
88,536	700	.0296	.0094	
94,860	750	.0342	.0113	
101,184	800	.0383	.0119	
107,508	850	.0410	.0128	
113,832	900	.0449	.0138	
120,156	950	.0498	.0155	
126,480	1,000	.0555	.0175	E (600–1,000) = 897,000 pounds per square inch.
132,804	1,050	.0615	.0205	
139,128	1,100	.0680	.0226	

No. 1657—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
145,452	1,150	.0739	.0255	
151,776	1,200	.0819	.0324	
158,100	1,250	.0980	.0420	
164,424	1,300	.1086	.0506	
170,748	1,350	.1201	.0665	
177,072	1,400	.1320	.0762	
183,396	1,450	.1454	.0879	
189,720	1,500	.1609	.1012	E (1,000–1,500) = 1,152,000 pounds per square inch.
196,044	1,550	.1770	.1160	
202,368	1,600	.1968	.1380	
.....	600	.1581	.1326	
.....	600	.1580	.1326	
.....	600	.1581	.1327	
.....	600	.1580	.....	
.....	1,000	.1756	.....	
.....	600	.1643	.1338	
.....	600	.1598	.....	
.....	1,000	.1759	.....	
.....	600	.1648	.1341 .1335	Set after resting 2 minutes.
208,692	1,650	.2200	.1543	
215,016	1,700	.2490	.1802	
226,800	1,793	.....	.....	Ultimate strength.

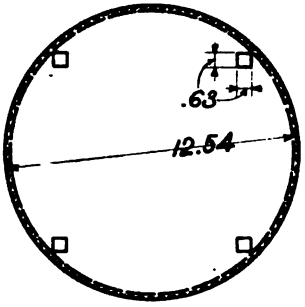
Column failed 2 feet from lower end.

No. 1658.

1 : 3 : 6 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing; also with 4 steel bars, each 94″.20 long.

Expanded metal, ″.16 wide by ″.13 thick; lathing ″.024 thick.



Composition, by volume: Alpha cement, 1; sand, 3; pebbles (¼″ to 1½″), 6.

Surface not plastered.

Age, set in air, 1 month 18 days.

Weight of column, total, 1,006 pounds.

Weight of concrete, 930 pounds = 141.3 pounds per cubic foot.

Weight of expanded metal and lathing, 33 pounds.

Weight of steel bars, 43 pounds.

Height of column, 94.20 inches.

Diameter of column, 12.54 inches; sectional area, gross, 123.50 square inches.

Sectional area of steel bars, ″.63 × ″.63 = □″.3969 × 4 = 1.59 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,350	100			Initial load. Loaded with 10,000 pounds before testing.
18,525	150	.0015	.0003	
24,700	200	.0032	.0006	
30,875	250	.0049	.0011	
37,050	300	.0066	.0015	
43,225	350	.0086	.0019	
49,400	400	.0108	.0024	
55,575	450	.0125	.0027	
61,750	500	.0148	.0035	
67,925	550	.0171	.0040	
74,100	600	.0193	.0044	E (100—600) = 1,678,000 pounds per square inch.
80,275	650	.0213	.0048	
86,450	700	.0239	.0053	
92,625	750	.0268	.0059	
98,800	800	.0293	.0064	
104,975	850	.0320	.0065	
111,150	900	.0357	.0069	
117,325	950	.0389	.0078	
123,500	1,000	.0417	.0075	E (600–1,000) = 1,086,000 pounds per square inch.
.....	600	.0309	.0074	
.....	600	.0309	.0075	
.....	600	.0310	.0075	

No. 1658—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
129,675	1,050	.0447	.0074	
139,850	1,100	.0458	.0074	
142,025	1,150	.0519	.0096	
148,200	1,200	.0564	.0118	
154,375	1,250	.0623	.0161	
160,550	1,300	.0690	.0217	
166,725	1,350	.0785	.0305	
172,900	1,400	.0869	.0385	
179,075	1,450	.0985	.0486	
185,250	1,500	.1094	.0583	E (1,000–1,500)=1,479,000 pounds per square inch.
.....	600	.0818	.0587	
.....	600	.0816	.0587	
.....	600	.0816	.0587	
191,425	1,550	.1220	.0690	
197,600	1,600	.1348	.0805	
203,775	1,650	.1478	.0919 .0910	Set after resting 45 minutes.
.....	600	.1128	.0915	
.....	600	.1129	.0916	
.....	600	.1129	.0916	
209,950	1,700	.1626	.1050	
216,125	1,750	.1828	.1241	
.....	600	.1454	.1243	
.....	600	.1451	.1242	
.....	600	.1450	.1241	
222,300	1,800	.2040	.1428	
.....	600	.1639	.1426	
.....	600	.1637	.1426	
.....	600	.1637	.1427	
236,000	1,911	.....	.....	Ultimate strength.

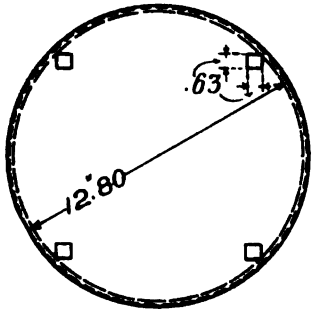
Failed near middle of length.

No. 1661.

1 : 2 : 5 Mixture.

Reënforced with cage of 3-inch mesh expanded metal, wrapped in steel lathing; also with 4 steel bars, each 95.85 inches long.

Expanded metal, ".23 wide by ".13 thick; lathing, ".024 thick.



Composition, by volume: Alpha cement, 1; sand, 2; pebbles ($\frac{1}{4}$" to $1\frac{1}{2}$"), 5.

Surface not plastered.

Age, set in air, 1 month 27 days.

Weight of column, total, 1,070 pounds.

Weight of concrete, 986 pounds = 141.5 pounds per cubic foot.

Weight of expanded metal and lathing, 41 pounds.

Weight of steel bars, 43 pounds.

Height of column, 95.85 inches.

Diameter of column, 12.80 inches; sectional area, gross, 128.68 square inches.

Sectional area of steel bars, ".63 × ".63 = □ ".3969 × 4 = 1.59 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,868	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
19,302	150	.0017	.0006	
25,736	200	.0061	.0011	
32,170	250	.0046	.0015	
38,604	300	.0068	.0021	
45,038	350	.0078	.0025	
51,472	400	.0095	.0029	
57,906	450	.0113	.0035	
64,340	500	.0128	.0038	
70,774	550	.0144	.0044	
77,208	600	.0163	.0047	E (100–600) = 2,155,000 pounds per square inch.
83,642	650	.0180	.0050	
90,076	700	.0198	.0055	
96,510	750	.0218	.0059	
102,944	800	.0233	.0065	
109,378	850	.0260	.0071	
115,812	900	.0280	.0075	
122,246	950	.0310	.0085	
128,680	1,000	.0330	.0089	E (600–1,000) = 1,600,000 pounds per square inch.

No. 1661—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0245	.0090	
.....	600	.0245	.0090	
135,114	1,050	.0355	.0097	
141,548	1,100	.0384	.0104	
147,982	1,150	.0406	.0110	
154,416	1,200	.0444	.0119	
160,850	1,250	.0461	.0121	
.....	600	.0312	.0123	
.....	600	.0314	.0123	
167,284	1,300	.0491	.0132	
173,718	1,350	.0525	.0144	
180,152	1,400	.0571	.0170	
186,586	1,450	.0615	.0199	
193,020	1,500	.0684	.0249	E (1,000-1,500) = 1,289,000 pounds per square inch.
.....	600	.0458	.0249	
.....	600	.0459	.0249	
199,454	1,550	.0730	.0280	
205,888	1,600	.0790	.0322	
202,322	1,650	.0843	.0368	
218,756	1,700	.0906	.0416	
225,190	1,750	.0965	.0465	
.....	600	.0668	.0467	
.....	600	.0666	.0469	
231,624	1,800	.1040	.0525	
238,058	1,850	.1106	.0580	
244,492	1,900	.1192	.0654	
250,926	1,950	.1299	.0747	
257,360	2,000	.1394	.0834	E (1,500-2,000) = 2,000,000 pounds per square inch.
.....	600	.1015	.0831	
.....	600	.1012	.0832	
263,794	2,050	.1500	.0924	
270,228	2,100	.1608	.1009	
281,000	2,184	.....	.....	Ultimate strength.

Failed about 2 feet from upper end.

TABULATION OF COMPRESSIVE STRENGTH OF CONCRETE AND MORTAR COLUMNS, PLAIN AND REËNFORCED WITH LONGITUDINAL STEEL BARS OR CAGES OF EXPANDED METAL AND STEEL LATHING.

Height of columns, 8 feet.

MORTAR COLUMNS, PLAIN.

No. of test.	Nominal size.	Brand of cement.	Composition.				Age.		Reënforcing metal.		Sectional areas, square inches.			Weight of concrete or mortar per cubic foot.	Compressive strength.	
			Cement.	Sand.	Stone or cinder.	Kind of stone or cinder.	Months.	Days.	Description.	Per cent of metal in column.	Gross.	Concrete or mortar.	Bars.		Total.	Per square inch on gross area.
														Pounds.	*Pounds.*	*Pounds.*
1682	12″ by 12″	Alpha	1	2			6		None		159.38	159.38		130.4	582,000	3,652
1684	do	do	1	2			6	3	None		158.00	158.00		129.6	398,100	2,488
1680	do	do	1	3			5	26	None		156.37	156.37		125.7	322,500	2,062
1681	do	do	1	3			5	27	None		157.13	157.13		127.1	423,000	2,692
1679	do	do	1	4			5	21	None		156.00	156.00		122.9	244,000	1,564
1685	do	do	1	4			6	9	None		157.75	157.75		122.3	232,100	1,471
1686	do	do	1	5			6	9	None		157.00	157.00		119.7	163,000	1,038
1687	do	do	1	5			6	18	None		158.76	158.76		120.1	171,800	1,082
MORTAR COLUMNS, REËNFORCED WITH LONGITUDINAL STEEL BARS, ¾-INCH SQUARE, TWISTED.																
1678	12″ by 12″	Alpha	1	2			5	10	8—¾″ bars	2.85	158.13	153.63	4.50	127.7	664,146	4,200
1690	do	do	1	3			7	21	do	2.87	157.00	152.50	4.50	125.9	608,000	3,841
1691	do	do	1	4			7	25	do	2.86	157.25	152.75	4.50	123.9	531,100	3,377
1688	do	do	1	5			6	17	do	2.86	157.50	153.00	4.50	118.1	443,000	2,813
1689	do	do	1	5			7	15	13—¾″ bars	4.63	157.75	150.44	7.31	120.0	616,000	3,905
CONCRETE COLUMNS, PLAIN.																
1656	12″ by 12″	Atlas	1	1	2	Trap rock, ¼″ to 1¼″	5	7	None		159.14	159.14		154.7	620,646	3,900
1683	do	Alpha	1	2	4	do	6	5	None		161.38	161.38		150.2	821,200	1,990
1650	do	Vulcanite	1	1	2	Pebbles, ¼″ to 1¼″	5	7	None		160.02	160.02		144.0	244,000	1,525
1651	do	do	1	2	4	do	5	6	None		160.64	160.64		144.9	242,000	1,506
1667	12″.7 diameter	Alpha	1	2	5	do	3	8	None		133.60	133.60		148.0	146,960	1,100
1649	12″ by 12″	Vulcanite	1	3	6	do	5	5	None		159.26	159.26		144.9	111,482	700
1655	do	Atlas	1	3	6	Cinders	5	6	None		159.39	159.39		107.1	169,000	1,060

TABULATION OF COMPRESSIVE STRENGTH OF CONCRETE AND MORTAR COLUMNS, PLAIN AND REËNFORCED WITH LONGITUDINAL STEEL BARS OR CAGES OF EXPANDED METAL AND STEEL LATHING—Continued.

CONCRETE COLUMNS, REËNFORCED WITH LONGITUDINAL STEEL BARS, ½-INCH SQUARE, TWISTED.

No. of test.	Nominal size.	Brand of cement.	Composition.				Age.		Reënforcing metal.		Sectional areas, square inches.			Weight of concrete or mortar per cubic foot.	Compressive strength.	
			Cement.	Sand.	Stone or cinder.	Kind of stone or cinder.	Months.	Days.	Description.	Per cent of metal in column.	Gross.	Concrete or mortar.	Bars.		Total.	Per square inch on gross area.
														Pounds.	*Pounds.*	*Pounds.*
1652	12″ by 12″	Vulcanite	1	2	4	Cinders	5	5	8—½″ bars	2.82	159.77	155.27	4.50	106.0	484,000	3,029
1653	do	Atlas	1	3	6	do	5	5	4—½″ bars	1.42	158.76	156.51	2.25	104.2	306,700	1,932
1654	do	do	1	3	6	do	5	6	8—½″ bars	2.83	159.01	154.51	4.50	108.4	498,000	3,100

CONCRETE COLUMNS, REËNFORCED WITH CAGES OF EXPANDED METAL, WITH OR WITHOUT STEEL LATHING.

1665	11″.04 diameter[a]	Alpha	1	2	5	Pebbles, ¼″ to 1½″	3	11	$\frac{1}{32}$″ metal and lathing		95.72			140.6	174,000	1,820
1666	12″.7 diameter	do	1	2	5	do	4	0	$\frac{1}{32}$″ metal only		133.60			146.3	187,040	1,400
1668	14″.7 diameter	do	1	2	5	do	3	8	do		178.75			148.9	259,188	1,450
1669	13″.35 diameter[a]	do	1	2	5	do	3	0	$\frac{1}{16}$″ metal and lathing		139.98			147.7	251,964	1,800
1663	13″.05 diameter[a]	do	1	2	5	do	1	22	do		133.76			150.1	334,000	2,497
1664	13″.12 diameter[a]	do	1	2	5	do	1	23	$\frac{1}{16}$″ metal and lathing		135.19			146.0	264,000	1,953
1642	13″.11 diameter[a]	do	1	3	6	Traprock, ¼″ to 1½″	2	2	$\frac{1}{32}$″ metal and lathing		134.99			138.5	233,000	1,730
1641	13″.36 diameter[a]	do	1	3	6	Pebbles, ¼″ to 1½″	2	2	$\frac{1}{16}$″ metal and lathing		140.18			142.1	244,000	1,740
1660	12″.40 diameter	do	1	2	5	do	1	18	$\frac{1}{32}$″ metal, lathing and 4—¼″ square bars.		120.76		.25	143.2	229,444	1,900
1662	12″.30 diameter	do	1	3	6	do	1	22	do		118.82		.25	145.7	198,000	1,666
1659	12″.56 diameter	do	1	2	5	do	1	27	$\frac{1}{16}$″ metal, lathing and 4—$\frac{5}{16}$″ diameter bars.		123.70		.96	147.6	285,000	2,304
1657	12″.69 diameter	do	1	3	6	do	1	3	do		126.48		.96	140.2	226,800	1,793
1658	12″.54 diameter	do	1	3	6	do	1	18	$\frac{1}{32}$″ metal, lathing and 4—¼″ square bars.		123.50		1.59	141.3	236,000	1,911
1661	12″.80 diameter	do	1	2	5	do	1	27	$\frac{1}{32}$″ metal, lathing and 4—¼″ square bars.		128.68		1.59	141.5	281,000	2,184

[a] Surface plastered with 1:2 mortar.

Concrete and Mortar Columns.

DEDUCED RESULTS ON REËNFORCED COLUMNS.

The following tables are deduced from the details of the tests, and show approximately the loads sustained by the concrete and by the steel reënforcing bars for columns of different mixtures, with different amounts of reënforcing metal and under different loads.

The figures in the first five columns of each table are taken from the details of the tests. The loads in pounds per square inch of the second column refer to the gross sectional area of the concrete and steel taken together.

The stresses on the bars shown in the sixth and seventh columns of the tables are computed from the resiliences on the gauged lengths, using a modulus of elasticity of 30,000,000 pounds per square inch for the steel. For example, the stress per square inch on the bars at 200 pounds per square inch on the gross sectional area of column No. 1673 is found to be $(30{,}000{,}000 \times ".0019) \div 50 = 1{,}140$ pounds, which, multiplied by the sectional area of the bars, 4.50, gives the total load on them, 5,130 pounds.

The figures in the eighth column, as indicated by the heading, are the differences between total loads on the column and those on the bars.

The several successive increments of load on the concrete appear in the next column.

In the tenth and eleventh columns are shown the relative loads on the concrete and the bars expressed in percentages, and have the same relations as those which exist between the figures in the eighth and seventh columns.

The stresses per square inch on the concrete of the twelfth column are the quotients obtained from the figures of the eighth column divided by the net sectional area of the concrete. The ratios of stresses per square inch of the bars to the concrete are shown in the last column of each table.

In the computation of the stresses per square inch on the reënforcing bars, and on which the figures of the tables in part rest, no account is taken of the effect of the initial load on the column.

MORTAR COLUMN No. 1673.

1:2 Mixture. Reënforced with 8—¾" twisted steel bars. Age, 5 months 10 days.

Sectional area of column, gross, 158.13 square inches; net, 153.63 square inches.

Sectional area of steel bars, 4.50 square inches.

Applied loads.		On 50" gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*			*Lbs.*	
15,818	100	0.	0.	0.								
31,626	200	.0022	.0003	.0019	1,140	5,130	26,496	.....	83.8	16.2	172	6.6
47,439	300	.0046	.0005	.0041	2,460	11,070	36,369	9,873	76.7	23.3	237	10.4
63,252	400	.0069	.0007	.0062	3,720	16,740	46,512	10,143	73.5	26.5	303	12.3
79,065	500	.0094	.0009	.0085	5,100	22,950	56,115	9,603	71.0	29.0	365	14.0
94,878	600	.0118	.0010	.0108	6,480	29,160	65,718	9,603	69.3	30.7	428	15.1
110,691	700	.0140	.0012	.0128	7,680	34,560	76,131	10,413	68.8	31.2	496	15.5
126,504	800	.0162	.0013	.0149	8,940	40,230	86,274	10,143	68.2	31.8	561	15.9
142,317	900	.0184	.0015	.0169	10,140	45,630	96,687	10,413	67.9	32.1	629	16.1
158,130	1,000	.0204	.0016	.0188	11,280	50,760	107,370	10,683	67.9	32.1	699	16.1
173,943	1,100	.0225	.0019	.0206	12,360	55,620	118,323	10,953	68.0	32.0	770	16.1
189,756	1,200	.0247	.0020	.0227	13,620	61,290	128,466	10,143	67.7	32.3	836	16.3
205,569	1,300	.0265	.0021	.0244	14,640	65,880	139,689	11,223	68.0	32.0	909	16.1
221,382	1,400	.0283	.0023	.0260	15,600	70,200	151,182	11,493	68.3	31.7	984	15.9
237,195	1,500	.0306	.0025	.0281	16,860	75,870	161,325	10,143	68.0	32.0	1,050	16.0
253,008	1,600	.0326	.0026	.0300	18,000	81,000	172,008	10,683	68.0	32.0	1,120	16.1
268,821	1,700	.0344	.0028	.0316	18,960	85,320	183,501	11,493	68.3	31.7	1,194	15.9
284,634	1,800	.0364	.0030	.0334	20,040	90,180	194,454	10,953	68.3	31.7	1,266	16.8
300,447	1,900	.0385	.0032	.0353	21,180	95,310	205,137	10,683	68.3	31.7	1,335	15.9
316,260	2,000	.0404	.0034	.0370	22,200	99,900	216,360	11,223	68.4	31.6	1,408	15.8
332,078	2,100	.0424	.0035	.0389	23,340	105,030	227,048	10,683	68.4	31.6	1,478	15.8
347,886	2,200	.0446	.0038	.0408	24,480	110,160	237,726	10,683	68.3	31.7	1,547	15.8
363,699	2,300	.0466	.0040	.0426	25,560	115,020	248,679	10,953	68.4	31.6	1,619	15.8
379,512	2,400	.0486	.0040	.0446	26,760	120,420	259,092	10,413	68.3	31.7	1,686	15.9
395,325	2,500	.0508	.0044	.0464	27,840	125,280	270,045	10,953	68.3	31.7	1,758	15.8
411,138	2,600	.0530	.0045	.0485	29,100	130,950	280,188	10,143	68.1	31.9	1,824	16.0
426,951	2,700	.0551	.0047	.0504	30,240	136,080	290,871	10,683	68.1	31.9	1,893	16.0
442,764	2,800	.0574	.0050	.0524	31,440	141,480	301,284	10,413	68.0	32.0	1,961	16.0
458,577	2,900	.0598	.0053	.0545	32,700	147,150	311,427	10,143	67.9	32.1	2,027	16.1
474,390	3,000	.0622	.0055	.0567	34,020	153,090	321,300	9,873	67.7	32.3	2,091	16.3
490,203	3,100	.0651	.0056	.0595	35,700	160,650	329,553	8,253	67.2	32.8	2,145	16.6
506,016	3,200	.0679	.0061	.0618	37,080	166,860	339,156	9,603	67.0	33.0	2,208	16.8
521,829	3,300	.0702	.0064	.0638	38,280	172,260	349,569	10,413	67.0	33.0	2,275	16.8
537,642	3,400	.0730	.0071	.0659	39,540	177,930	359,712	10,143	66.9	33.1	2,341	16.9
553,455	3,500	.0762	.0074	.0688	41,280	185,760	367,695	7,983	66.4	33.6	2,393	17.3
569,268	3,600	.0793	.0080	.0713	42,780	192,510	376,758	9,063	66.2	33.8	2,452	17.4
585,081	3,700	.0830	.0086	.0744	44,640	200,880	384,201	7,443	65.7	34.3	2,501	17.9
600,894	3,800	.0871	.0099	.0772	46,320	208,440	392,454	8,253	65.3	34.7	2,555	18.1
616,707	3,900	.0910	.0105	.0805	48,300	217,350	399,357	6,903	64.8	35.2	2,599	18.6
632,520	4,000	.0952	.0124	.0828	49,680	223,560	408,960	9,603	64.7	35.3	2,662	18.7
648,333	4,100	.0997	.0143	.0854	51,240	230,580	417,753	8,793	64.4	35.6	2,719	18.8
664,146	4,200	Ultimate strength.										

MORTAR COLUMN No. 1690.

1:3 Mixture. Reënforced with 8—¾″ twisted steel bars. Age, 7 months 21 days.

Sectional area of column, gross, 157 square inches; net, 152.50 square inches.

Sectional area of steel bars, 4.50 square inches.

Applied loads.		On 50″ gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*			*Lbs.*	
15,700	100	0.	0.									
31,400	200	.0021	.0001	.0020	1,200	5,400	26,000		82.8	17.2	170	7.1
47,100	300	.0044	.0008	.0041	2,460	11,070	36,030	10,030	76.5	23.5	236	10.4
62,800	400	.0071	.0005	.0066	3,960	17,820	44,980	8,950	71.6	28.4	295	13.4
78,500	500	.0096	.0008	.0088	5,280	23,760	54,740	9,760	69.7	30.3	359	14.7
94,200	600	.0120	.0009	.0111	6,660	29,970	64,230	9,490	68.2	31.8	421	15.8
109,900	700	.0143	.0010	.0133	7,980	35,910	73,990	9,760	67.3	32.7	485	16.5
125,600	800	.0167	.0011	.0156	9,360	42,120	83,480	9,490	66.5	33.5	547	17.1
141,300	900	.0189	.0013	.0176	10,560	47,520	93,780	10,300	66.4	33.6	615	17.2
157,000	1,000	.0211	.0014	.0197	11,820	53,190	103,810	10,030	66.1	33.9	681	17.4
172,700	1,100	.0232	.0015	.0217	13,020	58,590	114,110	10,300	66.1	33.9	748	17.4
188,400	1,200	.0253	.0016	.0237	14,220	63,990	124,410	10,300	66.0	34.0	816	17.4
204,100	1,300	.0275	.0018	.0257	15,420	69,390	134,710	10,300	66.0	34.0	883	17.5
219,800	1,400	.0298	.0020	.0278	16,680	75,060	144,740	10,030	65.9	34.1	949	17.6
235,500	1,500	.0320	.0021	.0299	17,940	80,730	154,770	10,030	65.7	34.3	1,015	17.7
251,200	1,600	.0343	.0025	.0318	19,080	85,860	165,340	10,570	65.8	34.2	1,084	17.6
266,900	1,700	.0364	.0027	.0337	20,220	90,990	175,910	10,570	65.9	34.1	1,153	17.5
282,600	1,800	.0388	.0030	.0358	21,480	96,660	185,940	10,030	65.8	34.2	1,219	17.6
298,300	1,900	.0411	.0032	.0379	22,740	102,330	195,970	10,030	65.7	34.3	1,285	17.7
314,000	2,000	.0433	.0035	.0398	23,880	107,460	206,540	10,570	65.8	34.2	1,354	17.6
329,700	2,100	.0458	.0038	.0420	25,200	113,400	216,300	9,760	65.6	34.4	1,418	17.8
345,400	2,200	.0480	.0040	.0440	26,400	118,800	226,600	10,300	65.6	34.4	1,486	17.8
361,100	2,300	.0505	.0044	.0461	27,660	124,470	236,630	10,030	65.5	34.5	1,552	17.8
376,800	2,400	.0534	.0047	.0487	29,220	131,490	245,310	8,680	65.1	34.9	1,609	18.2
392,500	2,500	.0561	.0050	.0511	30,660	137,970	254,530	9,220	64.8	35.2	1,669	18.4
408,200	2,600	.0589	.0055	.0534	32,040	144,180	264,020	9,490	64.7	35.3	1,731	18.5
603,000	3,841	Ultimate strength.										

Mortar Column No. 1691.

1:4 Mixture. Reënforced with 8—$\frac{3}{4}$" twisted steel bars. Age, 7 months 25 days.

Sectional area of column, gross, 157.25 square inches; net, 152.75 square inches.

Sectional area of steel bars, 4.50 square inches.

Applied loads.		On 50" gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Pounds*	*Pounds.*	*Pounds.*	*Pounds*			*Lbs.*	
15,725	100	0.	0.									
31,450	200	.0030	.0002	.0028	1,680	7,560	23,890	.....	76.0	24.0	156	10.8
47,175	300	.0069	.0005	.0064	3,840	17,280	29,895	6,005	63.4	36.6	196	19.6
62,900	400	.0104	.0008	.0096	5,760	25,920	36,980	7,085	58.8	41.2	242	23.8
78,625	500	.0138	.0009	.0129	7,740	34,830	43,795	6,815	55.7	44.3	287	27.0
94,350	600	.0169	.0010	.0159	9,540	42,930	51,420	7,625	54.5	45.5	337	28.3
110,075	700	.0198	.0011	.0187	11,220	50,490	59,585	8,165	54.1	45.9	390	28.8
125,800	800	.0223	.0012	.0211	12,660	56,970	68,830	9,245	54.7	45.3	451	28.1
141,525	900	.0248	.0015	.0233	13,980	62,910	78,615	9,785	55.5	44.5	514	27.2
157,250	1,000	.0272	.0015	.0257	15,420	69,390	87,860	9,245	55.9	44.1	575	26.8
172,975	1,100	.0295	.0015	.0280	16,800	75,600	97,375	9,515	56.3	43.7	637	26.4
188,700	1,200	.0320	.0017	.0303	18,180	81,810	106,890	9,515	56.7	43.3	700	26.0
204,425	1,300	.0350	.0025	.0325	19,500	87,750	116,675	9,785	57.1	42.9	764	25.5
220,150	1,400	.0374	.0027	.0347	20,820	93,690	126,460	9,785	57.4	42.6	828	25.1
235,875	1,500	.0395	.0029	.0366	21,960	98,820	137,055	10,595	58.1	41.9	897	24.5
251,600	1,600	.0424	.0031	.0393	23,580	106,110	145,490	8,435	57.8	42.2	952	24.8
267,325	1,700	.0447	.0032	.0415	24,900	112,050	155,275	9,785	58.1	41.9	1,017	24.5
283,050	1,800	.0478	.0035	.0443	26,580	119,610	163,440	8,165	57.7	42.3	1,070	24.8
298,775	1,900	.0499	.0039	.0460	27,600	124,200	174,575	11,135	58.4	41.6	1,143	24.1
314,500	2,000	.0525	.0040	.0485	29,100	130,950	183,550	8,975	58.4	41.6	1,202	24.2
330,225	2,100	.0547	.0040	.0507	30,420	136,890	193,335	9,785	58.5	41.5	1,266	24.0
345,950	2,200	.0578	.0043	.0535	32,100	144,450	201,500	8,165	58.2	41.8	1,319	24.3
361,675	2,300	.0606	.0045	.0561	33,660	151,470	210,205	8,705	58.1	41.9	1,376	24.5
377,400	2,400	.0635	.0046	.0589	35,340	159,030	218,370	8,165	57.9	42.1	1,430	24.7
393,125	2,500	.0665	.0050	.0615	36,900	166,050	227,075	8,705	57.8	42.2	1,487	24.8
531,100	3,377	Ultimate strength.										

MORTAR COLUMN No. 1688.

1:5 Mixture. Reënforced with 8—¾″ twisted steel bars. Age, 6 months 17 days.

Sectional area of column, gross, 157.50 square inches; net, 153 square inches.

Sectional area of steel bars, 4.50 square inches.

Applied loads.		On 50″ gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*			*Lbs.*	
15,750	100	0.	0.	0.								
31,500	200	.0035	0.	.0035	2,100	9,450	22,050	.....	70.0	30.0	144	14.6
47,250	300	.0075	.0002	.0073	4,380	19,710	27,540	5,490	58.3	41.7	180	24.3
63,000	400	.0114	.0006	.0108	6,480	29,160	33,840	6,300	53.7	46.3	221	29.3
78,750	500	.0147	.0007	.0140	8,400	37,800	40,950	7,110	52.0	48.0	268	31.3
94,500	600	.0181	.0010	.0171	10,260	46,170	48,330	7,380	51.1	48.9	316	32.5
110,250	700	.0202	.0001	.0201	12,060	54,270	55,980	7,650	50.8	49.2	366	33.0
126,000	800	.0235	.0004	.0231	13,860	62,370	63,630	7,650	50.5	49.5	416	33.3
141,750	900	.0265	.0006	.0259	15,540	69,930	71,820	8,190	50.7	49.3	469	33.1
157,500	1,000	.0293	.0008	.0285	17,100	76,950	80,550	8,730	51.1	48.9	526	32.5
173,250	1,100	.0326	.0009	.0317	19,020	85,590	87,660	7,110	50.6	49.4	573	33.2
189,000	1,200	.0358	.0010	.0348	20,880	93,960	95,040	7,380	50.3	49.7	621	33.6
204,750	1,300	.0386	.0006	.0380	22,800	102,600	102,150	7,110	49.9	50.1	668	34.1
220,500	1,400	.0420	.0010	.0410	24,600	110,700	109,800	7,650	49.8	50.2	718	34.3
236,250	1,500	.0460	.0013	.0447	26,820	120,690	115,560	5,760	48.9	51.1	755	35.5
252,000	1,600	.0497	.0017	.0480	28,800	129,600	122,400	6,840	48.6	51.4	800	36.0
267,750	1,700	.0535	.0020	.0515	30,900	139,050	128,700	6,300	48.1	51.9	841	36.7
283,500	1,800	.0574	.0024	.0550	33,000	148,500	135,000	6,300	47.6	52.4	882	37.4
443,000	2,813	Ultimate strength.										

Mortar Column No. 1689.

1:5 Mixture. Reënforced with 13—$\frac{3}{4}$" twisted steel bars. Age, 7 months 15 days.

Sectional area of column, gross, 157.75 square inches; net, 150.44 square inches.

Sectional area of steel bars, 7.31 square inches.

Applied loads.		On 50" gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*			*Lbs.*	
15,775	100	0.	0.									
31,550	200	.0024	.0002	.0022	1,320	9,649	21,901	.....	69.4	30.6	146	9.0
47,325	300	.0060	.0004	.0046	2,760	20,176	27,149	5,248	57.4	42.6	180	15.3
63,100	400	.0080	.0005	.0075	4,500	32,895	30,205	3,056	47.9	52.1	201	22.4
78,875	500	.0109	.0007	.0102	6,120	44,737	34,138	3,933	43.3	56.7	227	27.0
94,650	600	.0137	.0009	.0128	7,680	56,141	38,509	4,371	40.7	59.3	256	30.0
110.425	700	.0163	.0009	.0154	9,240	67,544	42,881	4,372	38.8	61.2	285	32.4
126,200	800	.0190	.0011	.0179	10,740	78,509	47,691	4,810	37.8	62.2	317	33.9
141,975	900	.0215	.0012	.0203	12,180	89,036	52,939	5,248	37.3	62.7	352	34.6
157,750	1,000	.0240	.0013	.0227	13,620	99,562	58,188	5,249	36.9	63.1	387	35.2
173,525	1,100	.0263	.0014	.0249	14,940	109,211	64,314	6,126	37.1	62.9	428	34.9
189,300	1,200	.0289	.0014	.0275	16,500	120,615	68,685	4,371	36.3	63.7	457	36.1
205,075	1,300	.0312	.0016	.0296	17,760	129,826	75,249	6,564	36.7	63.3	500	35.5
220,850	1,400	.0335	.0017	.0318	19,080	139,475	81,375	6,126	36.8	63.2	541	35.3
236,625	1,500	.0357	.0017	.0340	20,400	149,124	87,501	6,126	37.0	63.0	582	35.1
252,400	1,600	.0381	.0019	.0362	21,720	158,773	93,627	6,126	37.1	62.9	622	34.9
268,175	1,700	.0408	.0020	.0383	22,980	167,984	100,191	6,564	37.4	62.6	666	34.5
283,950	1,800	.0428	.0021	.0407	24,420	178,510	105,440	5,249	37.1	62.9	701	34.8
299,725	1,900	.0451	.0021	.0430	25,800	188,598	111,127	5,687	37.1	62.9	739	34.9
315,500	2,000	.0476	.0022	.0454	27,240	199,124	116,376	5,249	36.9	63.1	774	35.2
331,275	2,100	.0499	.0022	.0477	28,620	209,212	122,063	5,687	36.8	63.2	811	35.3
347,050	2,200	.0526	.0024	.0502	30,120	220,177	126,873	4,810	36.6	63 4	843	35.7
362,825	2,300	.0551	.0024	.0527	31,620	231,142	131,683	4,810	36.3	63.7	875	36.1
378,600	2,400	.0576	.0025	.0551	33,060	241,669	136,931	5,248	36.2	63.8	910	36.3
394,375	2,500	.0602	.0025	.0577	34,620	253,072	141,303	4,372	35.8	64.2	939	36.9
410,150	2,600	.0630	.0027	.0603	36,180	264,476	145,674	4,371	35.5	64.5	968	37.4
425,925	2,700	.0655	.0028	.0627	37,620	275,002	150,923	5,249	35.4	64.6	1,003	37.5
441,700	2,800	.0684	.0030	.0654	39,240	286,844	154,856	3,933	35.1	64.9	1,029	38.1
616,000	3,905	Ultimate strength.										

CONCRETE COLUMN NO. 1652.

1:2:4 Mixture. Cinders. Reënforced with 8—¾" twisted steel bars. Age, 5 months 5 days.

Sectional area of column, gross, 159.77 square inches; net, 155.27 square inches.

Sectional area of steel bars, 4.50 square inches.

Applied loads.		On 50" gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*			*Lbs.*	
15,977	100	0.	0.	0.								
31,954	200	.0023	0.	.0023	1,380	6,210	25,744		80.6	19.4	166	8.3
47,931	300	.0049	.0004	.0045	2,700	12,150	35,781	10,037	74.6	25.4	230	11.7
63,908	400	.0080	.0006	.0074	4,440	19,980	43,928	8,147	68.7	31.3	283	15.7
79,885	500	.0111	.0008	.0103	6,180	27,810	52,075	8,147	65.2	34.8	335	18.5
95,862	600	.0142	.0012	.0130	7,800	35,100	60,762	8,687	63.4	36.6	391	19.9
111,839	700	.0176	.0015	.0161	9,660	43,470	68,369	7,607	61.1	38.9	440	22.0
127,816	800	.0210	.0018	.0192	11,520	51,840	75,976	7,607	59.4	40.6	489	23.6
143,793	900	.0241	.0020	.0221	13,260	59,670	84,123	8,147	58.5	41.5	542	24.5
159,770	1,000	.0275	.0023	.0252	15,120	68,040	91,730	7,607	57.4	42.6	591	25.6
175,747	1,100	.0310	.0028	.0282	16,920	76,140	99,607	7,877	56.7	43.3	642	26.4
191,724	1,200	.0343	.0028	.0315	18,900	85,050	106,674	7,067	55.6	44.4	687	27.5
207,701	1,300	.0376	.0030	.0346	20,760	93,420	114,281	7,607	55.0	45.0	736	28.2
223,678	1,400	.0410	.0032	.0378	22,680	102,060	121,618	7,337	54.4	45.6	788	29.0
239,655	1,500	.0445	.0034	.0411	24,660	110,970	128,685	7,067	53.7	46.3	829	29.7
255,632	1,600	.0483	.0037	.0446	26,760	120,420	135,212	6,527	52.9	47.1	871	30.7
271,609	1,700	.0520	.0038	.0482	28,920	130,140	141,469	6,257	52.1	47.9	911	31.7
287,586	1,800	.0562	.0040	.0512	30,720	138,240	149,346	7,877	51.9	48.1	962	31.9
303,563	1,900	.0590	.0042	.0548	32,880	147,960	155,603	6,257	51.3	48.7	1,002	32.8
319,540	2,000	.0626	.0043	.0583	34,980	157,410	162,130	6,527	51.7	49.3	1,044	33.5
335,517	2,100	.0676	.0047	.0629	37,740	169,830	165,687	3,557	49.4	50.6	1,067	35.4
351,494	2,200	.0714	.0050	.0664	39,840	179,280	172,214	6,527	49.0	51.0	1,109	35.9
367,471	2,300	.0749	.0050	.0699	41,940	188,730	178,741	6,527	48.6	51.4	1,151	36.4
383,448	2,400	.0793	.0056	.0737	44,220	198,990	184,458	5,717	48.1	51.9	1,188	37.2
399,425	2,500	.0838	.0060	.0778	46,680	210,060	189,365	4,907	47.4	52.6	1,219	38.3
415,402	2,600	.0888	.0064	.0824	49,440	222,480	192,922	3,557	46.4	53.6	1,242	39.8
484,000	3,029	Ultimate strength.										

CONCRETE COLUMN No. 1653.

1:3:6 Mixture. Cinders. Reënforced with 4—$\frac{3}{4}$" twisted steel bars. Age, 5 months 5 days.

Sectional area of column, gross, 158.76 square inches; net, 156.51 square inches.

Sectional area of steel bars, 2.25 square inches.

Applied loads.		On 50" gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*			*Lbs.*	
15,876	100	0.	0.	0.	.....	.....	.....	.....	.....	.....	.....	.....
31,752	200	.0085	.0003	.0032	1,920	4,320	27,432	.....	86.4	13.6	175	11.0
47,628	300	.0076	.0008	.0068	4,080	9,180	38,448	11,016	80.7	19.3	246	16.6
63,504	400	.0124	.0012	.0112	6,720	15,120	48,384	9,936	76.2	23.8	309	21.7
79,380	500	.0169	.0017	.0152	9,120	20,520	58,860	10,476	74.1	25.9	376	24.3
95,256	600	.0218	.0023	.0195	11,700	26,325	68,931	10,071	72.4	27.6	440	26.6
111,132	700	.0276	.0036	.0240	14,400	32,400	78,732	9,801	70.5	29.2	503	28.6
127,008	800	.0327	.0041	.0286	17,160	38,610	88,398	9,666	69.6	30.4	565	30.4
142,884	900	.0380	.0048	.0332	19,920	44,820	98,064	9,666	68.6	31.4	627	31.8
158,760	1,000	.0444	.0054	.0390	23,400	52,650	106,110	8,046	66.8	33.2	678	34.5
174,636	1,100	.0493	.0059	.0434	26,040	58,590	116,046	9,936	66.5	33.5	741	35.1
190,512	1,200	.0550	.0067	.0483	28,980	65,205	125,307	9,261	65.8	34.2	801	36.2
206,388	1,300	.0606	.0071	.0535	32,100	72,225	134,163	8,856	65.0	35.0	857	37.5
222,264	1,400	.0674	.0081	.0593	35,580	80,055	142,209	8,046	64.0	36.0	909	39.1
238,140	1,500	.0746	.0093	.0653	39,180	88,155	149,985	7,776	63.0	37.0	958	40.9
254,016	1,600	.0823	.0108	.0715	42,900	96,525	157,491	7,506	62.0	38.0	1,006	42.6
269,892	1,700	.0906	.0128	.0778	46,680	105,030	164,862	7,371	61.1	38.9	1,053	44.3
285,768	1,800	.1006	.0157	.0849	50,940	114,615	171,153	6,291	59.9	40.1	1,094	46.6
306,700	1,932	Ultimate strength.										

CONCRETE COLUMN No. 1654.

1:3:6 Mixture. Cinders. Reënforced with 8—$\frac{3}{4}$" twisted steel bars.
Sectional area of column, gross, 159.01 square inches; net, 154.51 square inches.
Sectional area of steel bars, 4.50 square inches.

Applied loads.		On 50" gauged length.			Computed stress on bars.		Total stress on concrete, by difference.	Increment on concrete.	Per cent of load on—		Stress per square inch on concrete.	Ratio, pounds per square inch, bars to concrete.
Total.	Per square inch.	Compression.	Set.	Resilience.	Per square inch.	Total.			Concrete.	Bars.		
Pounds.	*Lbs.*	*Inch.*	*Inch.*	*Inch.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*			*Lbs.*	
15,901	100	0.	0.	0.	.....	.....	.....	.....	.....	.....	.....	.....
31,802	200	.0019	0.	.0019	1,140	5,130	26,672	.....	83.9	16.1	178	6.6
47,703	300	.0044	0.	.0044	2,640	11,880	35,823	9,151	75.1	24.9	232	11.4
63,604	400	.0072	.0004	.0068	4,080	18,360	45,244	9,421	71.1	28.9	293	13.9
79,505	500	.0114	.0003	.0111	6,660	29,970	49,535	4,291	62.3	37.7	321	20.7
95,406	600	.0133	.0003	.0130	7,800	35,100	60,306	10,771	63.2	36.8	390	20.0
111,307	700	.0162	.0005	.0157	9,420	42,390	68,917	8,611	61.9	38.1	446	21.1
127,208	800	.0198	.0011	.0187	11,220	50,490	76,718	7,801	60.3	39.7	497	22.6
143,109	900	.0231	.0014	.0217	13,020	58,590	84,519	7,801	59.1	40.9	547	23.8
159,010	1,000	.0263	.0016	.0247	14,820	66,690	92,320	7,801	58.1	41.9	598	24.8
174,911	1,100	.0308	.0027	.0281	16,860	75,870	99,041	6,721	56.6	43.4	641	26.3
190,812	1,200	.0346	.0029	.0317	19,020	85,590	105,222	6,181	55.1	44.9	681	27.9
206,713	1,300	.0377	.0032	.0345	20,700	93,150	113,563	8,341	54.9	45.1	735	28.2
222,614	1,400	.0411	.0033	.0378	22,680	102,060	120,554	6,991	54.2	45.8	780	29.1
238,515	1,500	.0449	.0036	.0413	24,780	111,510	127,005	6,451	53.2	46.8	822	30.1
254,416	1,600	.0488	.0038	.0450	27,000	121,500	132,916	5,911	52.2	47.8	860	31.4
270,317	1,700	.0521	.0039	.0482	28,920	130,140	140,177	7,261	51.9	48.1	907	31.9
286,218	1,800	.0558	.0040	.0518	31,080	139,860	146,358	6,181	51.1	48.9	947	32.8
302,119	1,900	.0596	.0041	.0555	33,300	149,850	152,269	5,911	50.4	49.6	985	33.8
318,020	2,000	.0633	.0043	.0590	35,400	159,300	158,720	6,451	49.9	50.1	1,027	34.5
333,921	2,100	.0682	.0046	.0636	38,160	171,720	162,201	3,481	48.6	51.4	1,050	36.3
349,822	2,200	.0721	.0046	.0675	40,500	182,250	167,572	5,371	47.9	52.1	1,085	37.3
365,723	2,300	.0761	.0048	.0713	42,780	192,510	173,213	5,641	47.4	52.6	1,121	38.2
381,624	2,400	.0807	.0051	.0756	45,360	204,120	177,504	4,291	46.5	53.5	1,149	39.5
397,525	2,500	.0856	.0059	.0797	47,820	215,190	182,335	4,831	45.9	54.1	1,180	40.5
413,426	2,600	.0908	.0068	.0840	50,400	226,800	186,626	4,291	45.1	54.9	1,208	41.7
429,327	2,700	.0971	.0085	.0886	53,160	239,220	190,107	3,481	44.3	55.7	1,230	43.2
445,228	2,800	.1042	.0111	.0931	55,860	251,370	193,858	3,751	43.5	56.5	1,255	44.5
493,000	3,100	Ultimate strength.										

CEMENT EXPOSED TO LOADS OF CUBIC COMPRESSION.

NEAT PORTLAND CEMENT.

SHOWING REDUCED SIZE OF THE UPPER CUBE, DUE TO LOAD OF

30,000 POUNDS PER SQUARE INCH, CUBIC COMPRESSION.

HEWES & POTTER, BOSTON.

CEMENT SUBJECTED TO CUBIC COMPRESSION.

A cube of neat Star Portland cement was exposed to a load of 30,000 pounds per square inch cubic compression. The cube was one of a batch of cement which was held in the mixing bed for a period of 102 hours after mixing, before it was tamped into the mold. The present test was made when the cube was 3 years 8 months old.

By reason of its treatment at the time of gauging, the cube was light in weight and porous. It was prepared for receiving a load of compression, to be simultaneously applied to each of its six sides, by encasing in a thin sheet-brass envelope, which was sealed by soldering against the admission of water. When thus prepared, it was placed in an hydrostatic cylinder and exposed to a pressure of 30,000 pounds per square inch.

This pressure effected a considerable permanent reduction in volume without, however, appearing to affect the integrity of the material. The primitive dimensions of the cube were

$$2''.98 \times 2''.98 \times 3''.01 = 26.73 \text{ cubic inches.}$$

After loading with 30,000 pounds per square inch, the dimensions were

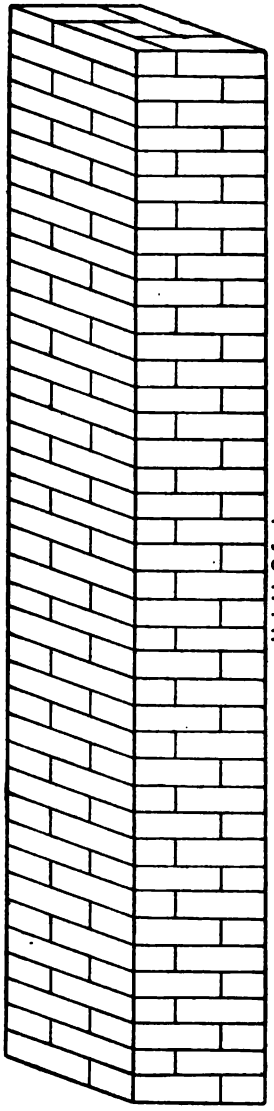
$$2''.68 \times 2''.70 \times 2''.74 = 19.83 \text{ cubic inches.}$$

Its reduction in volume was 6.9 cubic inches = 25.8 per cent.

The weight of the cube was 1 pound $4\frac{3}{4}$ ounces, which, in its primitive condition, equals 83.68 pounds per cubic foot, and, after loading, equals 112.78 pounds per cubic foot. Its gain in weight was therefore 29.10 pounds per cubic foot, or 34.8 per cent. These results correspond to a specific gravity before loading of 1.341, and after loading, 1.807.

A second sample of neat cement was exposed to a load of 100,000 pounds per square inch cubic compression. This was a cylindrical specimen, 1″ diameter and $1\frac{1}{4}$″ long, taken from a cylinder of neat Portland cement which was gauged with 5 per cent water and set under high initial pressure, but without having been held in the mixing bed, as in the case of the above cube. The dimensions of this cylinder were only slightly affected by the loading, being reduced about ″.01 each in diameter and length. The cylinder remained intact and apparently uninjured by the load to which it had been subjected.

BRICK PIERS.



Brick piers, nominally 12″ by 12″ in cross-section dimensions by 8 feet high, with solid and hollow cores, were made of repressed, wire-cut, and sand-lime face bricks; also hard and light-hard sand-struck and water-struck bricks. The several kinds of brick were of burnt clay, excepting the sand-lime material.

These piers were laid in neat cement, cement mortar, and lime mortar.

Mention is made, in the details of the test, of loads which were applied before testing. This refers to the load which it was necessary to apply to hold the piers together during transportation and while adjusting them in an horizontal position in the machine in which the tests were made.

No. 1672.

12" FACE BRICK PIER.

Repressed brick from New England Brick Company's yard, Exeter, N. H.
Built of 39 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 4 months 8 days.
Weight, 868 pounds=126.3 pounds per cubic foot.
Height of pier, 96.75 inches.
Outside dimensions, 11".85×11".93=141.37 square inches.
Core, 4".32×4".32=18.66 square inches.
Net sectional area, 122.71 square inches.
Average thickness of joints, ".23.
Gauged length, 50".
Laid with close end joints.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,271	100	0.	0.	Initial load. Loaded with 14,500 pounds before testing.
18,407	150	.0020	.0002	
24,542	200	.0040	.0005	
30,678	250	.0059	.0008	
36,813	300	.0076	.0010	
42,949	350	.0095	.0010	
49,084	400	.0114	.0011	
55,220	450	.0130	.0012	
61,355	500	.0150	.0014	
67,491	550	.0168	.0016	
73,626	600	.0188	.0018	E (100-600)=1,471,000 pounds per square inch.
.....	600	.0190	.0019	
85,897	700	.0225	.0022	
98,168	800	.0267	.0024	
110,439	900	.0304	.0028	
122,710	1,000	.0346	.0031	E (600-1,000)=1,379,000 pounds per square inch.
.....	600	.0211	.0033	
.....	600	.0211	.0032	
134,981	1,100	.0386	.0036	
147,252	1,200	.0429	.0040	
159,523	1,300	.0469	.0044	
171,794	1,400	.0513	.0051	
184,065	1,500	.0560	.0057	
.....	600	.0245	.0057	
.....	600	.0245	.0057	
196,336	1,600	.0508	.0064	
208,607	1,700	.0659	.0072	
220,878	1,800	.0708	.0082	
233,149	1,900	.0760	.0092	
245,420	2,000	.0824	.0105	E (1,000-2,000)=1,238,000 pounds per square inch.
.....	600	.0315	.0109	
.....	600	.0314	.0106	
257,691	2,100	.0895	.0128	Snapping sounds.
258,500	2, 106	.....	.....	Ultimate strength.

Opened longitudinal cracks along the middle and lower part of the pier.

No. 1671.

12" FACE BRICK PIER.

Wire cut, face brick from Messrs. Fiske & Co., Boston, Mass.
Built of 37 courses of brick, with solid core.
Laid in cement mortar—1 part Alpha cement and 2 parts sand.
Age, 2 months 12 days.
Weight, 1,078 pounds=134.4 pounds per cubic foot.
Height of pier, 96.45 inches.
Sectional area, 11".95×12".02=143.64 square inches.
Average thickness of joints, ".30.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,364	100	0.	0.	Initial load. Loaded with 13,000 pounds before testing.
21,546	150	.0008	0.	
28,728	200	.0019	.0008	
35,910	250	.0029	.0004	
43,092	300	.0039	.0005	
50,274	350	.0049	.0006	
57,456	400	.0058	.0008	
64,638	450	.0069	.0009	
71,820	500	.0078	.0010	
79,002	550	.0089	.0010	
86,184	600	.0101	.0012	E (100–600)=2,809,000 pounds per square inch.
.....	600	.0101	.0012	
100,548	700	.0119	.0013	
114,912	800	.0138	.0014	
129,276	900	.0159	.0016	
143,640	1,000	.0179	.0018	E (600–1,000)=2,778,000 pounds per square inch.
.....	600	.0111	.0019	
.....	600	.0111	.0019	
158,004	1,100	.0201	.0020	
172,368	1,200	.0222	.0022	
186,732	1,300	.0244	.0024	
201,096	1,400	.0264	.0027	
215,460	1,500	.0285	.0028	
229,824	1,600	.0306	.0030	Snapping sound.
244,188	1,700	.0329	.0031	
258,552	1,800	.0350	.0036	
272,916	1,900	.0373	.0037	
287,280	2,000	.0394	.0039	E (1,000–2,000)=2,577,000 pounds per square inch.
301,644	2,100	.0418	.0040	
316,008	2,200	.0440	.0045	
344,736	2,400	.0482	.0046	
373,464	2,600	.0527	.0054	
.....	100	.....	.0048	Pier rested under initial load 22 hours.
.....	200	.0070	.....	
.....	300	.0092	.....	
.....	400	.0114	.....	
.....	500	.0138	.....	
.....	600	.0160	.....	
.....	500	.0140	.....	
.....	400	.0120	.....	
.....	300	.0098	.....	
.....	200	.0075	.0061	
.....	200	.0074	.....	
.....	400	.0119	.....	
.....	600	.0161	.....	
.....	800	.0202	.....	
.....	1,000	.0241	.....	
.....	1,200	.0280	.....	
.....	1,400	.0318	.....	
.....	1,600	.0356	.....	
.....	1,800	.0393	.....	
.....	2,000	.0429	.....	

No. 1671—Continued.

Applied loads.		In gauged lengths.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	1,800	.0399	.....	
.....	1,600	.0365	.....	
.....	1,400	.0330	.....	
.....	1,200	.0294	.....	
.....	1,000	.0257	.....	
.....	800	.0219	.....	
.....	600	.0178	.....	
.....	400	.0132	.....	
.....	200	.0082	.0058	
373,464	2,600	.0540	.0063	
402,192	2,800	.0584	.0066	
430,920	3,000	.0630	.0072	E (2,000-3,000)=2,468,000 pounds per square inch.
459,648	3,200	.0688	.0079	
488,376	3,400	.0739	.0087	
517,104	3,600	.0808	.0100	Cracks in several courses.
542,000	3,773	.....	.....	Ultimate strength.

Opened longitudinal cracks along middle of length of pier.

No. 1676.

12" COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's yard, West Cambridge, Mass.
Built of 38 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 4 months 13 days.
Weight, 808 pounds=134.6 pounds per cubic foot.
Height of pier, 94.55 inches.
Outside dimensions, 11".40×11".43=130.30 square inches.
Core, 4".52×4".55=20.57 square inches.
Net sectional area, 109.73 square inches.
Average thickness of joints, ".30.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
10,973	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
16,460	150	.0009	.0001	
21,946	200	.0017	.0001	
27,433	250	.0026	.0002	
32,919	300	.0035	.0003	
38,406	350	.0045	.0004	
43,892	400	.0054	.0004	
49,379	450	.0064	.0006	
54,865	500	.0075	.0007	
60,352	550	.0085	.0007	
65,838	600	.0095	.0007	E (100-600)=2,841,000 pounds per square inch.
.....	600	.0096	.0007	
76,811	700	.0116	.0009	
87,784	800	.0137	.0011	
98,757	900	.0158	.0013	
109,730	1,000	.0179	.0015	E (600-1,000)=2,682,000 pounds per square inch.
.....	600	.0106	.0016	
.....	600	.0106	.0016	
120,703	1,100	.0202	.....	
131,676	1,200	.0222	.0019	
142,649	1,300	.0245	.....	Snapping sounds.
153,622	1,400	.0269	.....	
164,595	1,500	.0293	.0027	
.....	600	.0123	.0026	
.....	600	.0123	.0026	
175,568	1,600	.0327	.....	
186,541	1,700	.0357	.....	
197,514	1,800	.0390	.0050	
208,487	1,900	.0416	.....	
219,460	2,000	.0435	.0068	E (1,000-2,000)=2,847,000 pounds per square inch.
.....	600	.0163	.0060	
.....	600	.0168	.0060	
.....	600	.0168	.0059	

No. 1676—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
230, 433	2, 100	.0475	.....	
241, 406	2, 200	.0497	.0071	
252, 379	2, 300	.0529	.0079	
263, 352	2, 400	.0564	.0086	
274, 325	2, 500	.0620	.0108	
.....	600	.0231	.0107	
.....	600	.0228	.0107	
285, 298	2, 600	.0670	.0121	Snapping sounds renewed.
294, 000	2, 680	.....	.....	Ultimate strength.

Opened longitudinal cracks at middle of length.

No. 1677.

12″ COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's yard, West Cambridge, Mass.
Built of 36 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 4 months 14 days.
Weight, 757 pounds=112 pounds per cubic foot.
Height of pier, 94.95 inches.
Outside dimensions, 12″×11″.93=143.16 square inches.
Core, 4″.48×4″.50=20.16 square inches.
Net sectional area, 123 square inches.
Average thickness of joints, ″.33.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,300	100	0.	0.	Initial load. Loaded with 10,500 pounds before testing.
18,450	150	.0081	.0007	
24,600	200	.0064	.0015	
30,750	250	.0098	.0018	
36,900	300	.0129	.0023	
43,050	350	.0162	.0026	
49,200	400	.0197	.0030	
55,350	450	.0230	.0033	
61,500	500	.0262	.0038	
67,650	550	.0297	.0041	
73,800	600	.0331	.0047	E (100–600)=830,000 pounds per square inch.
.....	600	.0337	.0048	
86,100	700	.0408	.0055	
98,400	800	.0475	.0064	
110,700	900	.0550	.0075	
123,000	1,000	.0628	.0085	E (600–1,000)=772,000 pounds per square inch.
.....	600	.0406	.0086	
.....	600	.0405	.0086	
135,300	1,100	.0706	.0100	Snapping sounds.
147,600	1,200	.0797	.0116	
159,900	1,300	.0921	.0156	
163,000	1,325	.....	.....	Ultimate strength.

Opened cracks along middle of length.

No. 1670.

12″ COMMON BRICK PIER.

Light-hard, sand struck brick from New England Brick Company's yard, East Brookfield, Mass.
Built of 36 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 3 parts sand.
Age, 2 months 12 days.
Weight, 792 pounds=110.3 pounds per cubic foot.
Height of pier, 96.50 inches.
Outside dimensions, 12″.50×12″.46=155.75 square inches.
Core, 5″.30×5″.12=27.13 square inches.
Net sectional area, 128.62 square inches.
Average thickness of joints, ″.40.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,862	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
19,293	150	.0052	.0018	
25,724	200	.0103	.0035	
32,155	250	.0155	.0050	
38,586	300	.0204	.0064	
45,017	350	.0254	.0078	
51,448	400	.0305	.0091	
57,879	450	.0361	.0104	
64,310	500	.0414	.0116	Snapping sounds. No cracks visible.
70,741	550	.0466	.0129	
77,172	600	.0519	.0144	E (100–600)=667,000 pounds per square inch.
.....	600	.0580	.0151	
.....	600	.0587	.0155	
90,034	700	.0684	.0173	
102,896	800	.0750	.0203	E (600–800)=581,000 pounds per square inch.
115,758	900	.....	.....	Ultimate strength.

The maximum load was sustained only momentarily.
Pier failed near the lower end.
The bricks in 7 courses, second to eighth from bottom, crushed.

No. 1674.

12" COMMON BRICK PIER.

Light-hard, sand struck brick from New England Brick Company's yard, East Brookfield, Mass.
Built of 37 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 2 parts sand.
Age, 4 months 11 days.
Weight, 762 pounds=107 pounds per cubic foot.
Height of pier, 96.75 inches.
Outside dimensions, 12".32×12".20=150.30 square inches.
Core, 4".77×4".85=23.13 square inches.
Net sectional area, 127.17 square inches.
Average thickness of joints, ".32.
Gauged length, 50".
Laid with close end joints.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,717	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
19,076	150	.0084	.0005	
25,434	200	.0068	.0010	
31,793	250	.0108	.0016	
38,151	300	.0144	.0020	
44,510	350	.0184	.0026	
50,868	400	.0224	.0032	
57,227	450	.0265	.0038	
63,585	500	.0298	.0042	
69,944	550	.0346	.0050	
76,302	600	.0388	.0055	E (100–600)=751,000 pounds per square inch.
.....	600	.0395	.0059	
89,019	700	.0477	.0072	
101,736	800	.0563	.0084	
114,453	900	.0655	.0098	
127,170	1,000	.0749	.0112	E (600–1,000)=658,000 pounds per square inch.
.....	600	.0493	.0115	
.....	600	.0492	.0118	
139,887	1,100	.0866	.0140	Bricks in second and third course from lower end cracked.
152,604	1,200	.0998	.0171	
162,000	1,274	.....	.....	Ultimate strength.

Failure occurred in the lower courses of the pier. Opened longitudinal cracks.

No. 1675.

12″ COMMON BRICK PIER.

Hard, sand-struck brick from New England Brick Company's yard, Mechanicsville, N. Y.
Built of 37 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 4 months 12 days.
Weight, 712 pounds = 106.1 pounds per cubic foot.
Height of pier, 95.90 inches.
Outside dimensions, 11″.90 × 11″.93 = 141.97 square inches.
Core, 4″.50 × 4″.67 = 21.01 square inches.
Net sectional area, 120.96 square inches.
Average thickness of joints, ″.30.
Gauged length, 50″.
Laid with close end joints.

Applied loads.		In gauged lengths.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,096	100	0.	0.	Initial load. Loaded with 15,500 pounds before testing.
18,144	150	.0018	.0001	
24,192	200	.0037	.0004	
30,240	250	.0060	.0008	
36,288	300	.0084	.0015	
42,336	350	.0105	.0019	
48,384	400	.0129	.0028	
54,432	450	.0147	.0031	
60,480	500	.0175	.0035	
66,528	550	.0190	.0033	
72,576	600	.0212	.0040	E (100–600) = 1,458,000 pounds per square inch.
.....	600	.0216	.0043	
84,672	700	.0258	.0049	
96,768	800	.0302	.0053	
108,864	900	.0350	.0065	
120,960	1,000	.0398	.0078	E (600–1,000) = 1,307,000 pounds per square inch.
.....	600	.0271	.0075	
.....	600	.0271	.0075	
133,056	1,100	.0449	.0079	
145,152	1,200	.0517	.0088	
157,248	1,300	.0572	.0095	
169,344	1,400	.0629	.0102	
181,440	1,500	.0680	.0112	
.....	600	.0343	.0112	
.....	600	.0343	.0112	
198,536	1,600	.0740	.0121	Snapping sounds.
204,000	1,656	.....	.....	Ultimate strength.

Opened longitudinal cracks in upper part of pier.

No. 1644.

12" COMMON BRICK PIER.

Hard, water-struck brick from New England Brick Company's Yard No. 34, Rochester, N. H.
Built of 40 courses of brick, with solid core.
Laid in neat Portland cement, Atlas brand.
Age, 5 months 24 days.
Weight, 1,043 pounds=133.2 pounds per cubic foot.
Height of pier, 94.77 inches.
Sectional area, 12"×11".90=142.80 square inches.
Average thickness of joints, ".35.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,280	100	0.	0.	Initial load. Loaded with 20,000 pounds before testing.
21,420	150	.0015	.0001	
28,560	200	.0034	.0004	
35,700	250	.0049	.0006	
42,840	300	.0065	.0009	Snapping sounds.
49,980	350	.0082	.0011	
57,120	400	.0100	.0014	
64,260	450	.0115	.0016	
71,400	500	.0129	.0019	
78,540	550	.0145	.0020	
85,680	600	.0161	.0022	E (100–600)=1,799,000 pounds per square inch.
99,960	700	.0198	.0024	
114,240	800	.0221	.0029	
128,520	900	.0251	.0030	
142,800	1,000	.0280	.0031	E (600–1,000)=1,818,000 pounds per square inch.
157,080	1,100	.0310	.0036	
171,360	1,200	.0339	.0038	
185,640	1,300	.0367	.0039	
199,920	1,400	.0396	.0042	
214,200	1,500	.0426	.0045	
.....	200	.0075	.....	
.....	300	.0108	.....	
.....	400	.0139	.....	
.....	500	.0168	.....	
.....	600	.0198	.....	
.....	700	.0226	.....	
.....	800	.0252	.....	
.....	900	.0278	.....	
.....	1,000	.0305	.....	
.....	900	.0281	.....	
.....	800	.0258	.....	
.....	700	.0232	.....	
.....	600	.0206	.....	
.....	500	.0179	.....	
.....	400	.0149	.....	
.....	300	.0117	.....	
.....	200	.0083	.0047	
228,480	1,600	.0455	.0048	
242,760	1,700	.0484	.0051	
257,040	1,800	.0513	.0054	
271,320	1,900	.0542	.0057	
285,600	2,000	.0569	.0058	E (1,000–2,000)=1,908,000 pounds per square inch.

No. 1644—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
314,160	2,200	.0621	.0062	
342,720	2,400	.0678	.0068	
371,280	2,600	.0732	.0071	
399,840	2,800	.0789	.0076	
428,400	3,000	.0843	.0080	E (2,000–3,000)=1,984,000 pounds per square inch.
456,960	3,200	.0900	.0085	
485,520	3,400	.0961	.0091	
514,080	3,600	.1018	.0098	
542,640	3,800	.1068	.0108	Cracks in middle courses of bricks.
571,200	4,000	.1150	.0114	E (3,000–4,000)=1,832,000 pounds per square inch.
650,000	4,552	.....	.....	Ultimate strength.

Opened cracks along middle of pier, separating bricks into halves.

No. 1645.

12″ COMMON BRICK PIER.

Hard, water-struck brick from New England Brick Company's yard No. 34, Rochester, N. H.
Built of 38 courses of brick, with solid core.
Laid in cement mortar—1 part Atlas cement and 3 parts sand.
Age, 5 months 22 days.
Weight, 1,031 pounds=130.3 pounds per cubic foot.
Height of pier, 96.10 inches.
Sectional area, 11″.90×11″.96=142.32 square inches.
Average thickness of joints, ″.38.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,232	100	0.	0.	Initial load. Loaded with 19,000 pounds before testing.
21,348	150	.0014	.0005	
28,464	200	.0029	.0006	
35,580	250	.0042	.0009	
42,696	300	.0056	.0010	
49,812	350	.0070	.0015	
56,928	400	.0085	.0016	
64,044	450	.0098	.0017	
71,160	500	.0114	.0018	
78,276	550	.0128	.0020	
85,392	600	.0141	.0023	E (100–600)=2,119,000 pounds per square inch.
99,624	700	.0170	.0026	
113,856	800	.0198	.0029	
128,088	900	.0228	.0031	
142,320	1,000	.0260	.0038	E (600–1,000) = 1,923,000 pounds per square inch.
156,552	1,100	.0283	.0041	
170,780	1,200	.0319	.0047	
185,016	1,300	.0350	.0050	
199,248	1,400	.0380	.0052	
213,480	1,500	.0416	.0061	
227,712	1,600	.0447	.0067	
241,944	1,700	.0480	.0074	
256,176	1,800	.0516	.0082	
270,408	1,900	.0557	.0091	
284,640	2,000	.0593	.0100	E (1,000–2,000) = 1,845,000 pounds per square inch.
313,104	2,200	.0667	.0117	
341,568	2,400	.0750	.0134	
370,032	2,600	.0836	.0161	
398,496	2,800	.0930	.0189	
426,960	3,000	.1035	.0221	E (2,000–3,000) = 1,558,000 pounds per square inch.
487,000	3,422	.....	.....	Ultimate strength.

Opened cracks along the lower third of the pier.

No. 1648.

12" COMMON BRICK PIER.

Hard, water-struck brick from New England Brick Company's yard No. 34, Rochester, N. H.
Built of 38 courses of brick, with solid core.
Laid in lime mortar—1 part lime and 3 parts sand.
Age, 5 months 3 days.
Weight, 947 pounds = 121.9 pounds per cubic foot.
Height of pier, 96.40 inches.
Sectional area, 11".70 × 11".90 = 139.23 square inches.
Average thickness of joints, ".40.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
13,923	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
20,885	150	.0122	.0087	
27,846	200	.0380	.0303	
34,808	250	.0757	.0635	
41,769	300	.1190	.1019	
48,731	350	.1598	.1380	
55,692	400	.2069	.1800	
62,654	450	.2588	.2275	
69,615	500	.3048	.2690	Crack in one course.
76,577	550	.3587	.3181	E (100–550) = 554,000 pounds per square inch.
65,000	467	.....	.....	Sustained for a period of 1 hour.
133,000	955	.....	.....	Ultimate strength.

No. 1643.

12" COMMON BRICK PIER.

Light-hard, water-struck brick from New England Brick Company's yard No. 12, Epping, N. H.
Built of 36 courses of brick, with solid core.
Laid in neat Portland cement, Atlas brand.
Age, 5 months 23 days.
Weight, 1,025 pounds=120.4 pounds per cubic foot.
Height of pier, 95.50 inches.
Sectional area, 12".50×12".35=154.38 square inches.
Average thickness of joints, ".35.
Gauged length. 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,438	100	0.	0.	Initial load.
23,157	150	.0080	.0008	
30,876	200	.0067	.0014	Snapping sounds.
38,595	250	.0100	.0016	
46,314	300	.0134	.0023	
54,033	350	.0169	.0027	Cracks in the neat cement.
61,752	400	.0201	.0084	
69,471	450	.0238	.0089	
77,190	500	.0271	.0044	
84,909	550	.0307	.0049	
92,628	600	.0342	.0055	E (100-600)=871,000 pounds per square inch.
108,066	700	.0408	.0063	
123,504	800	.0476	.0070	
138,942	900	.0548	.0082	
154,380	1,000	.0618	.0098	E (600-1,000)=840,000 pounds per square inch.
169,818	1,100	.0691	.0102	
185,256	1,200	.0764	.0116	
200,694	1,300	.0836	.0126	
216,132	1,400	.0910	.0127	
231,570	1,500	.0993	.0151	
247,008	1,600	.1076	.0166	
262,446	1,700	.1167	.0186	
277,884	1,800	.1276	.0212	Cracks in two courses of bricks.
287,700	1,864	.....	.....	Ultimate strength.

Snapping sounds were repeated during the progress of the test.
The cement in the joints cracked in many places, the cracks making their appearance early in the test.

No. 1646.

12″ COMMON BRICK PIER.

Light-hard, water-struck brick from New England Brick Company's yard No. 12, Epping, N. H.
Built of 34 courses of brick, with solid core.
Laid in cement mortar—1 part Atlas cement and 3 parts sand.
Age, 5 months 5 days.
Weight, 981 pounds=119.3 pounds per cubic foot.
Height of pier, 96.25 inches.
Sectional area, 12″.05×12″.30=148.22 square inches.
Average thickness of joints, ″.55.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,822	100	0.	0.	Initial load. Loaded with 15,500 pounds before testing.
22,233	150	.0031	.0006	
29,644	200	.0063	.0013	
37,055	250	.0095	.0021	
44,466	300	.0125	.0027	
51,877	350	.0157	.0031	
59,288	400	.0189	.0039	
66,699	450	.0220	.0041	
74,110	500	.0251	.0050	
81,521	550	.0284	.0056	
88,932	600	.0317	.0061	E (100-600)=977,000 pounds per square inch.
103,754	700	.0383	.0077	
118,576	800	.0450	.0086	
133,398	900	.0520	.0101	
148,220	1,000	.0590	.0109	E (600-1,000)=889,000 pounds per square inch.
163,042	1,100	.0662	.0127	
177,864	1,200	.0740	.0144	
192,686	1,300	.0830	.0165	
207,508	1,400	.0921	.0194	
222,330	1,500	.1023	.0222	
232,000	1,565	.....	.....	Ultimate strength.

Opened cracks along the middle of the length of the pier.

No. 1647.

12″ COMMON BRICK PIER.

Light-hard, water-struck brick from New England Brick Company's yard No. 12, Epping, N. H.
Built of 36 courses of brick, with solid core.
Laid in lime mortar—1 part lime and 3 parts sand.
Age, 5 months 5 days.
Weight, 940 pounds=114.3 pounds per cubic foot.
Height of pier, 97.10 inches.
Sectional area, 12″.10×12″.10=146.41 square inches.
Average thickness of joints, ″.35.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
14,641	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
21,962	150	.0135	.0086	
29,282	200	.0346	.0287	
36,603	250	.0594	.0428	
43,923	300	.0682	.0658	
51,244	350	.1206	.0917	
58,564	400	.1582	.1179	
65,885	450	.1910	.1498	
73,205	500	.2250	.1789	Cracks in 6 courses.
80,526	550	.2618	.2097	
87,846	600	.3035	.2449	E (100-600)=427,000 pounds per square inch.
95,500	652	.....	.....	Ultimate strength.

No. 1678.

12″ FACE BRICK PIER.

Sand-lime brick, made by Huenneke's system at Atlantic City, N. J.
Built of 37 courses of brick, with solid core.
Laid in neat Alpha cement.
Age, 4 months 18 days.
Weight, 1,050 pounds=118 pounds per cubic foot.
Height of pier, 95.60 inches.
Sectional area, 12″.67×12″.69=160.78 square inches.
Average thickness of joints, ″.18.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
16,078	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
24,117	150	.0025	.0010	
32,156	200	.0055	.0022	
40,195	250	.0086	.0031	
48,234	300	.0114	.0040	
56,273	350	.0141	.0048	
64,312	400	.0173	.0066	
72,351	450	.0207	.0069	
80,390	500	.0235	.0079	
88,429	550	.0266	.0091	Snapping sounds.
96,468	600	.0294	.0097	E (100–600)=1,269,000 pounds per square inch.
.....	600	.0299	.0100	
104,507	650	.0328	.0108	
112,546	700	.0357	.0118	
120,585	750	.0388	.0125	
128,624	800	.0421	.0138	
136,663	850	.0449	.0146	
144,702	900	.0481	.0159	
152,741	950	.0513	.0168	
160,780	1,000	.0546	.0177	E (600–1,000)=1,163,000 pounds per square inch.
.....	600	.0410	.0179	
.....	600	.0410	.0178	
168,819	1,050	.0585	.0198	
176,858	1,100	.0620	.0207	
184,897	1,150	.0655	.0218	
192,936	1,200	.0690	.0251	
200,975	1,250	.0727	.0243	
.....	600	.0490	.0240	
.....	600	.0490	.0241	
209,014	1,300	.0757	.0255	
217,053	1,350	.0795	.0266	
225,092	1,400	.0838	.0284	
233,130	1,450	.0883	.0302	
241,170	1,500	.....	.....	Ultimate strength.

Opened longitudinal cracks in the lower half of the pier.

TABULATION OF COMPRESSIVE TESTS OF BRICK PIERS.

Nominal dimensions, 12″×12″×8 feet high.

Piers laid in neat Portland cement, cement mortar, and lime mortar.

The bricks from West Cambridge, East Brookfield, and Mechanicsville were sand struck; those from Rochester and Epping were water-struck bricks.

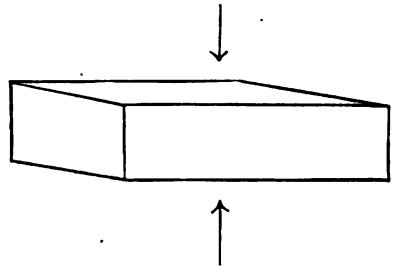
No. of test.	Description of bricks.	Pier laid in—	Age.		Weight per cubic foot.	Sectional area.	Compressive strength.		Moduli of elasticity between loads per square inch of—			Permanent set on gauged length of 50″ after loads in pounds per square inch of—		
							Total.	Per square inch.	100 and 600.	600 and 1,000.	1,000 and 2,000.	600.	1,000.	2,000.
			Mos.	*Days.*	*Pounds.*	*Sq. in.*	*Pounds.*	*Lbs.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Inch.*	*Inch.*
1672	Face, repressed, mud bricks	1 cement, 5 sand	4	8	126.3	122.71	258,500	2,106	1,471,000	1,379,000	1,238,000	.0018	.0081	.0105
1671	Face, wire cut, mud bricks	1 cement, 2 sand	2	12	134.4	143.64	542,000	3,773	2,809,000	2,778,000	2,577,000	.0012	.0018	.0039
1676	Hard, West Cambridge, Mass	1 cement, 5 sand	4	13	134.6	109.73	294,000	2,680	2,841,000	2,632,000	2,347,000	.0007	.0015	.0058
1677	Light-hard, West Cambridge, Mass	do	4	14	112.0	123.00	163,000	1,325	880,000	772,000		.0047	.0085	
1670	Light-hard, East Brookfield, Mass	1 cement, 3 sand	2	12	110.3	128.62	115,758	900	667,000			.0144		
1674	do	1 cement, 5 sand	4	11	107.0	127.17	162,000	1,274	751,000	658,000		.0055	.0112	
1675	Hard, Mechanicsville, N. Y	do	4	12	106.1	120.96	204,000	1,686	1,453,000	1,307,000		.0040	.0073	
1644	Hard, Rochester, N. H	Neat cement	5	24	138.2	142.80	650,000	4,552	1,799,000	1,818,000	1,908,000	.0022	.0031	.0058
1645	do	1 cement, 3 sand	5	22	130.3	142.32	487,000	3,422	2,119,000	1,923,000	1,845,000	.0023	.0038	.0100
1648	do	1 lime, 3 sand	5	3	121.9	139.23	133,000	955	[a] 554,000			[a] .3181		
1643	Light-hard, Epping, N. H	Neat cement	5	23	120.4	154.38	287,700	1,864	871,000	840,000		.0055	.0093	
1646	do	1 cement, 3 sand	5	5	119.3	148.22	232,000	1,565	977,000	889,000		.0061	.0109	
1647	do	1 lime, 3 sand	5	5	114.3	146.41	95,500	652	427,000			.2449		
1678	Face, sand-lime bricks, Huenneke's system.	Neat cement	4	18	118.0	160.78	241,170	1,500	1,269,000	1,163,000		.0097	.0177	

[a] Taken at 550 pounds.

SAND-LIME BRICKS.

Absorption and Compression Tests of Sand-Lime Bricks.

Material furnished by the Tennessee Granite Brick Company, Memphis, Tenn.



Compressed surfaces faced with plaster of paris.

Serial No.	Dimensions.					Compressive strength.	
	Height.	Compressed surface.		Sectional area.	First crack.	Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
1	2.31	4.01	8.26	33.20	185,000	218,000	6,570
2	2.30	4.02	8.28	33.29	216,000	248,400	7,460
3	2.30	4.02	8.28	33.29	192,000	213,000	6,400

ABSORPTION TESTS.

Bricks Nos. 4, 5, and 6 were immersed in water for a period of one week.

Serial No.	Weight.					Absorption.	
	Before immersion.		After immersion.		Gain.	By weight.	By volume.
	Pounds.	*Ounces.*	*Pounds.*	*Ounces.*	*Ounces.*	*Per cent.*	*Per cent.*
4	5	6	5	14	8	9.3	18.0
5	5	1¼	5	9½	8¼	10.1	18.9
6	5	5¼	5	13	7¾	8.8	16.8

Bricks 4, 5, and 6 were returned to the water bath, where they remained for an additional period of 18 days, after which they were tested while wet, immediately after being taken out of the water.

Serial No.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
4	2.32	4.01	8.28	33.20	139,000	189,000	5,690
5	2.27	4.02	8.28	33.29	81,000	181,000	5,440
6	2.32	4.01	8.28	33.20	108,000	195,800	5,900
Bricks Nos. 7, 8, and 9 were saturated with water, after which they were frozen, thawed out in water, and refrozen—in all six times. They were then thawed out and tested at temperature of the room:							
7	2.31	4.01	8.28	33.20	164,000	186,000	5,600
8	2.29	4.01	8.27	33.16	165,000	192,500	5,810
9	2.31	4.02	8.28	33.29	166,000	204,000	6,130
Brick No. 9 showed cracks on two corners upon the second freezing, which reached a length of about 1¼" at the third freezing, but did not extend during subsequent freezings. Nos. 7 and 8 did not develop any cracks.							
Bricks Nos. 10, 11, and 12 were heated over an open wood fire for a period of one hour, slowly cooled, and tested the following day:							
10	2.28	4.01	8.27	33.16	.....	114,000	3,440
11	2.30	4.01	8.27	33.16	.....	180,000	5,430
12	2.29	4.01	6.24	25.02	.....	79,900	3,190
Numerous cracks were formed in Nos. 10, 11, and 12 during heating.							

GRANITE.

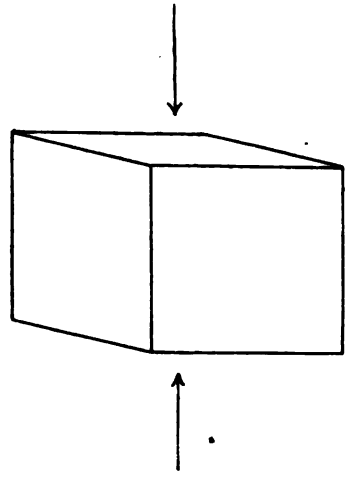
Material quarried by the Balfour Quarry Company, Asheville, N. C., and contributed for testing by Mr. H. J. Stanley, Chief Engineer, Board of Public Service, Cincinnati, Ohio.

The granite from which cubes 1 to 6, inclusive, were made came from a quarry located near a hamlet called Granite Quarry, about 5 miles southeast of Salisbury, N. C.

The granite from which cubes 7 to 12, inclusive, were made came from the Balfour granite quarry, near Balfour Station, about 18 miles south of Asheville, N. C.

The cubes were worked in the rough to $2\frac{1}{2}''$ on a side, then reducing them on a rubbing bed to their finished dimensions.

COMPRESSION TESTS OF GRANITE CUBES.



Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
1	2.05	2.08	2.03	4.22	159,000	218,800	50,660
2	2.07	2.04	2.02	4.12	152,000	179,900	43,670
3	2.04	2.07	2.02	4.18	155,000	214,200	51,240
4	2.06	2.06	2.03	4.18	140,000	215,400	51,580
5	2.05	2.08	2.03	4.22	143,000	201,100	47,650
6	2.05	2.08	2.03	4.22	187,000	219,400	51,990
7	2.06	2.03	2.04	4.14	141,000	141,000	34,060
8	2.03	2.03	2.04	4.14	104,000	117,600	28,410
9	2.03	2.05	2.04	4.18	122,000	128,500	30,740
10	2.03	2.06	2.02	4.16	112,000	144,000	34,620
11	2.03	2.06	2.04	4.20	86,000	114,000	27,140
12	2.03	2.04	2.04	4.16	101,000	130,500	31,370

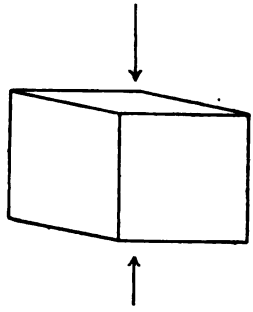
Pyramidal fractures.

MARBLE.

COMPRESSION TEST OF MARBLE CUBES.

Specimens received from Hon. A. J. Foster, chairman of the Committee on the Geological Survey, United States Senate, Washington, D. C.

Furnished by the International Consolidated Development Mining and Brokerage Company, Tacoma, Wash.



Dimensions.				First crack.	Compressive strength.	
Height.	Compressed surface.		Sectional area.		Total.	Per square inch.
Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*
2.04	2.03	2.03	4.12	36,700	36,700	8,910
2.04	2.03	2.03	4.12	38,060	38,060	9,240

Pyramidal fractures.

TENSILE TESTS OF BLUE-PRINT AND BROWN-PRINT PAPERS, BROWN-PRINT CLOTH, AND TRACING CLOTH.

Length of specimens between jaws, 3".
Length of specimens over all, 5".
The cloth was tested two ways. Warp or filling not identified as such.

BLUE-PRINT PAPER.

No. of sample.	Width.	Thickness.	Sectional area.	Tests.			Mean results.		Remarks.
				First.	Second.	Third.	Total.	Per square inch.	
	Inch.	*Inch.*	*Sq. in.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
1	1	.0039	.0039	26¼	27	25	26.2	6,720	
2	1	.0039	.0039	26¼	24¼	27	26.0	6,670	
3	1	.0051	.0051	22¼	22	22	22.2	4,350	
4	1	.0043	.0043	28¼	28	29	28.5	6,630	
9	1	.0043	.0043	17	16	16½	16.5	3,840	
15	1	.0048	.0048	26	25½	30	27.2	5,670	
16	1	.0034	.0034	20½	21	20½	20.6	6,060	
23	1	.0040	.0040	27¼	27	26½	27.0	6,750	
30	1	.0037	.0037	27	26½	27¼	27.0	7,300	
31	1	.0036	.0036	16	16	15¼	15.8	4,390	
32	1	.0041	.0041	24	23	23	23.3	5,680	
33	1	.0051	.0051	37	39	39	38.3	7,510	

BROWN-PRINT PAPER.

10	1	.0021	.0021	12	12	11¼	11.9	5,670	
17	1	.0037	.0037	26¼	29¼	30½	28.8	7,780	
18	1	.0028	.0028	26¼	26¼	27	26.7	9,540	
24	1	.0038	.0038	21	21	20	20.7	5,450	
25	1	.0032	.0032	28	29¼	28¼	28.6	8,940	
34	1	.0030	.0030	18¼	21	19	19.5	6,500	

BROWN-PRINT CLOTH.

5	1	.0050	.0050	36¼	.....	.....	36.5	7,300	In one direction.
6	1	.0050	.0050	34	.....	.....	34.0	6,800	Do.
7	1	.0050	.0050	38	.....	.....	38.0	7,600	In the other direction.
8	1	.0050	.0050	42	.....	.....	42.0	8,400	Do.
11	1	.0047	.0047	28¼	.....	.....	28.5	6,060	In one direction.
12	1	.0047	.0047	40	.....	.....	40.0	8,510	Do.
13	1	.0047	.0047	25	.....	.....	25.0	5,320	In the other direction.
14	1	.0047	.0047	30	.....	.....	30.0	6,380	Do.
19	1	.0055	.0055	41	.....	.....	41.0	7,450	In one direction.
20	1	.0055	.0055	36	.....	.....	36.0	6,550	Do.
21	1	.0055	.0055	28	.....	.....	28.0	5,090	In the other direction.
22	1	.0055	.0055	26	.....	.....	26.0	4,730	Do.
26	1	.0050	.0050	44½	.....	.....	44.5	8,900	In one direction.
27	1	.0050	.0050	42½	.....	.....	42.5	8,500	Do.
28	1	.0050	.0050	35½	.....	.....	35.5	7,100	In the other direction.
29	1	.0050	.0050	33	.....	.....	33.0	6,600	Do.
35	1	.0052	.0052	32½	.....	.....	32.5	6,250	In one direction.
36	1	.0052	.0052	38	.....	.....	38.0	7,310	Do.
37	1	.0052	.0052	19	.....	.....	19.0	3,650	In the other direction.
38	1	.0052	.0052	20½	.....	.....	20.5	3,940	Do.

TRACING CLOTH.

39	1	.0029	.0029	25	.....	.....	25.0	8,620	In one direction.
40	1	.0029	.0029	24½	.....	.....	24.5	8,450	Do.
41	1	.0029	.0029	58	.....	.....	58.0	20,000	In the other direction.
42	1	.0029	.0029	57	.....	.....	57.0	19,660	Do.

PRIVATE TESTS.

TESTS MADE FOR PRIVATE PARTIES DURING THE FISCAL YEAR ENDED JUNE 30, 1905.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1904.				
July 6	Cordage	Plymouth Cordage Co.	North Plymouth	Mass.
9	Cast iron	Farrel Foundry and Machine Co.	Ansonia	Conn.
	Steel wire rope	J. A. Roebling's Sons Co.	Trenton	N. J.
11	Wire-rope blocks	Boston and Lockport Block Co.	Boston	Mass.
13	Cast-iron jack screws.	Vaughn Machine Co.	Peabody	Mass.
16	Cast steel	Barbour-Stockwell Co	Cambridgeport	Mass.
19	Sand brick	National Art Stone Co	Chester	Pa.
	Concrete	Eastern Expanded Metal Co.	Boston	Mass.
20	Wrought iron	Wyman & Gordon	Worcester	Mass.
22	Concrete slabs	Eastern Expanded Metal Co.	Boston	Mass.
	Kaladar actinolite	The Cummings Cement Co.	Akron	N. Y.
23	Sand brick	National Art Stone Co	Chester	Pa.
25	Cast iron	Barbour-Stockwell Co.	Cambridgeport	Mass.
27	Iron and steel bars	Wyman & Gordon	Worcester	Mass.
30	Wire chain	J. B. Huberdeau	Quincy	Mass.
	Steel specimens	Isaac G. Johnson & Co.	Spuyten-Duyvil	N. Y.
Aug. 5	do	Wyman & Gordon	Worcester	Mass.
6	Wire-rope socket	J. H. Williams Co.	Brooklyn	N. Y.
	Rubber belting	Revere Rubber Co.	Chelsea	Mass.
8	Concrete	Eastern Expanded Metal Co.	Boston	Mass.
11	Wire rope	J. A. Roebling's Sons Co.	Trenton	N. J.
12	Hoisting link	Yale & Towne Manufacturing Co.	Stamford	Conn.
	Breaker links	Plymouth Cordage Co.	North Plymouth	Mass.
13	Concrete	S. E. Thompson	Newton Highlands.	Mass.
23	Briquettes	A. B. Murdough	Watertown	Mass.
	Manganese steel	C. A. Blackall	Boston	Mass.
25	Wrought iron	Wyman & Gordon	Worcester	Mass.
	Steel specimen	Savage Arms Co.	Utica	N. Y.
	Wires	Boston Transit Commission	Boston	Mass.
	Manganese steel	C. A. Blackall	do	Mass.
26	Granite	Balfour Quarry Co.	Salisbury	N. C.
Sept. 1	Sand-lime brick	Waldo Bros	Boston	Mass.
2	Steel, cast iron, and bronze specimens.	The Wellman-Seaver-Morgan Co.	Cleveland	Ohio.
	Canvas belting	The American Belting Co.	Youngstown	Ohio.
	Rubber belting	Revere Rubber Co	Chelsea	Mass.
3	do	do	do	Mass.
6	Bronze	Victor Metals Co.	East Braintree	Mass.
	Concrete	Eastern Expanded Metal Co.	Boston	Mass.
7	do	do	do	Mass.
8	do	do	do	Mass.
7	Carbonic-acid cylinders.	Merrimac Chemical Co.	North Woburn	Mass.
19	Coppers for pressure gauges.	Robin Hood Powder Co.	Swanton	Vt.
20	Links and chains	The Thos. Laughlin Co.	Portland	Me.
21	Bronze	Victor Metals Co.	East Braintree	Mass.
22	Wrought iron	Wyman & Gordon	Worcester	Mass.
23	Adhesion of wire nails in wood.	Hood Rubber Co.	Watertown	Mass.
26	Bronze	Victor Metals Co.	East Braintree	Mass.
30	Chain links	Plymouth Cordage Co.	North Plymouth	Mass.
Oct. 4	Steel bars	Wyman & Gordon	Worcester	Mass.
	Bronze	The Taunton-New Bedford Copper Co.	Taunton	Mass.
	do	The Wm. Cramp & Sons Ship and Engine Building Co.	Philadelphia	Pa.
5	Granite	City of Cincinnati	Cincinnati	Ohio.
6	Bricks	E. P. Cottle	Buffalo	N. Y.
	do	W. W. Barclay	Pattersonville	N. Y.
15	Plain and twisted steel bars.	Boston Transit Commission.	Boston	Mass.
18	Canvas belting	Ruboil-Belting Co	do	Mass.
19	Concrete beams	Greenfield Electric Light and Power Co.	Greenfield	Mass.
21	Bronze	Victor Metals Co.	East Braintree	Mass.
27	Paper and soldered joints.	Hood Rubber Co.	Watertown	Mass.
	Wrought iron	Wason Manufacturing Co	Brightwood	Mass.
29	Cast iron	The Detrick & Harvey Machine Co.	Baltimore	Md.

PRIVATE TESTS—Continued.

TESTS MADE FOR PRIVATE PARTIES DURING THE FISCAL YEAR ENDED JUNE 30, 1905—Continued.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1904.				
Oct. 29	Steel	Colonial Steel Co	Boston	Mass.
31	Lally columns	New York Fire Proof Column Co.	New York	N. Y.
Nov. 3	Bronze	Builders Iron Foundry	Providence	R. I.
	.....do	The Wm. Cramp & Sons Ship and Engine Building Co.	Philadelphia	Pa.
4	Stone	Alfred Giles	San Antonio	Tex.
	Bricks	Watertown Sand Brick Co	Watertown	N. Y.
	.....do	City of Scranton, Pa	Scranton	Pa.
5	.....do	.....do	.....do	Pa.
7	.....do	.....do	.....do	Pa.
	Concrete prisms	Eastern Expanded Metal Co	Boston	Mass.
8	Steel bars	Boston Transit Commission	.....do	Mass.
9	.....do	.....do	.....do	Mass.
10	.....do	.....do	.....do	Mass.
11	Steel plate and riveted joints.	Waters Governor Co	.....do	Mass.
12	Adhesion of nails in wood.	Hood Rubber Co	Watertown	Mass.
	Sandstone	D'Oench & Yost	New York	N. Y.
	Bronze	Builders Iron Foundry	Providence	R. I.
16	Steel	Colonial Steel Co	Boston	Mass.
19	.....do	Wyman & Gordon	Worcester	Mass.
22	Bronze	Builders Iron Foundry	Providence	R. I.
23	Steel	Colonial Steel Co	Boston	Mass.
	Cast iron	Vaughn Machine Co	Peabody	Mass.
26	Manila rope	Plymouth Cordage Co	North Plymouth	Mass.
28	Bronze	Victor Metals Co	East Braintree	Mass.
30	Cast iron	Farrel Foundry and Machine Co.	Ansonia	Conn.
Dec. 3	Steel rods	Boston Transit Commission	Boston	Mass.
6	Rubber belting	Revere Rubber Co	Chelsea	Mass.
7	Joints in belting	Leonard Waldo	New York	N. Y.
8	Steel bars	Boston Transit Commission	Boston	Mass.
9	.....do	.....do	.....do	Mass.
12	Steel	Savage Arms Co	Utica	N. Y.
14	Steel bars	Marlin Firearms Co	New Haven	Conn.
15	Cast-iron rollers	H. I. Crandall & Son Co	East Boston	Mass.
	Steel tubing	Standard Coupler Co	New York	N. Y.
16	Steel	Wyman & Gordon	Worcester	Mass.
20	Bronze	Victor Metals Co	East Braintree	Mass.
	Steel	The Pennsylvania Steel Co	Steelton	Pa.
27	Aluminum	Vaughn Machine Co	Peabody	Mass.
28	Chain	Thomson Electric Welding Co.	Lynn	Mass.
1905.				
Jan. 4	Aluminum	Vaughn Machine Co	Peabody	Mass.
9	Bronze	Victor Metals Co	East Braintree	Mass.
14	Aluminum	Vaughn Machine Co	Peabody	Mass.
16	Bricks, paving and fire.	Shawmut Paving Brick Works	Shawmut	Pa.
	Sand-lime bricks	Tennessee Granite Brick Co	Memphis	Tenn.
19	Twisted steel rods	Boston Transit Commission	Boston	Mass.
20	Shackles	Fletcher & Crowell Co	Portland	Me.
21	Manila rope	Fearing, Whiton & Co	Boston	Mass.
	.....do	Plymouth Cordage Co	North Plymouth	Mass.
31	Steel	Savage Arms Co	Utica	N. Y.
Feb. 2	Hemp rope	Albert Winslow & Co	Boston	Mass.
3	Chains	Thomson Electric Welding Co.	Lynn	Mass.
	Lally patent columns.	New York Fire Proof Column Co.	New York	N. Y.
4	.....do	.....do	.....do	N. Y.
6	Lally columns and cast-iron columns.	Lally Patent Column Co	Waltham	Mass.
7	.....do	.....do	.....do	Mass.
	Ball bearings	The Chapman Double Ball Bearing Co. of America.	Boston	Mass.
8	Welded-steel plate	The Continental Iron Works	Brooklyn	N. Y.
	Sand-lime bricks	Tennessee Granite Brick Co	Memphis	Tenn.
	Register frames	George Thompson	Everett	Mass.
9	Steel-wire rope	The Carson Trench Machine Co.	Charlestown	Mass.
Mar. 4	Steel	Savage Arms Co	Utica	N. Y.
	.....do	Wyman & Gordon	Worcester	Mass.
7	Manila rope	Plymouth Cordage Co	North Plymouth	Mass.
8	Corrugated and twisted bars.	Boston Transit Commission	Boston	Mass.

PRIVATE TESTS—Continued.

TESTS MADE FOR PRIVATE PARTIES DURING THE FISCAL YEAR ENDED JUNE 30, 1905—Continued.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1905.				
Mar. 9	Rubber belting	Revere Rubber Co	Chelsea	Mass.
11	Steel	The Brown Wire Gun Co	New York	N. Y.
15	....do	Mix & Hartel	Boston	Mass.
	Cement and concrete.	Bush Terminal Co	New York	N. Y.
16	Wire rope	American Steel and Wire Co	Worcester	Mass.
	....do	Carson Trench Machine Co	Charlestown	Mass.
20	Concrete	Bush Terminal Co	New York	N. Y.
21	Swivels	Fletcher & Crowell Co	Portland	Me.
29	Bronze	The Wm. Cramp & Sons Ship and Engine Building Co.	Philadelphia	Pa.
	Canvas belting	The American Belting Co	Youngstown	Ohio.
30	Aluminum alloys	Thomas Pray, jr	Boston	Mass.
Apr. 10	Cast iron	Farrel Foundry and Machine Co.	Ansonia	Conn.
12	....do	Thomas Pray, jr	Boston	Mass.
14	Tubing and pipe	Lally Patent Column Co	Waltham	Mass.
	Building blocks	Wm. S. Humbert (Incorporated)	Niagara Falls	N. Y.
	....do	Berthelet Construction Co	Milwaukee	Wis.
15	Concrete	Boston Transit Commission	Boston	Mass.
17	Turn-buckles	....do	....do	Mass.
18	Cast iron	Farrel Foundry and Machine Co.	Ansonia	Conn.
	Cordage	Plymouth Cordage Co	North Plymouth	Mass.
19	Shackles and swivels.	Fletcher & Crowell Co	Portland	Me.
21	Bronze	Thomas Pray, jr	Boston	Mass.
24	Steel	Wyman & Gordon	Worcester	Mass.
	....do	Savage Arms Co	Utica	N. Y.
25	Sheet steel	Ames Shovel and Tool Co	North Easton	Mass.
	Steel tubing	Thomas Pray, jr	Boston	Mass.
28	Cloth	Hood Rubber Co	Watertown	Mass.
May 6	Wood	Merrimac Chemical Co	North Woburn	Mass.
12	Steel	Laconia Car Co. Works	Boston	Mass.
	....do	Wyman & Gordon	Worcester	Mass.
13	Bronze plate	The Wm. Cramp & Sons Ship and Engine Building Co.	Philadelphia	Pa.
	Granite cubes	John Pierce	New York	N. Y.
15	Wooden insulators	A. & J. M. Anderson Mfg. Co	South Boston	Mass.
	Twisted steel bars	Boston Transit Commission	Boston	Mass.
16	Steel tubing	Thomas Pray, jr	....do	Mass.
18	Steel	Wyman & Gordon	Worcester	Mass.
	Manila rope	Columbian Rope Co	Auburn	N. Y.
20	Hemp rope	Plymouth Cordage Co	North Plymouth	Mass.
24	Steel-wire rope	American Steel and Wire Co	Worcester	Mass.
25	....do	....do	....do	Mass.
26	Steel	Wyman & Gordon	....do	Mass.
27	....do	....do	....do	Mass.
June 3	Granite cubes	City of Cincinnati	Cincinnati	Ohio.
	Bronze	Thomas Pray, jr	Boston	Mass.
5	Malleable-iron links	Plymouth Cordage Co	North Plymouth	Mass.
6	Hydraulic test gauges	Star Brass Mfg. Co	Boston	Mass.
10	Steel bar	Wyman & Gordon	Worcester	Mass.
12	Steel bars embedded in cement.	Trussed Concrete Steel Co	Detroit	Mich.
13	Steel bars	Boston Transit Commission	Boston	Mass.
14	....do	....do	....do	Mass.
	Shackles	Boston and Lockport Block Co	....do	Mass.
	Granite	Wm. N. Flynt Granite Co	Monson	Mass.
17	Steel	Savage Arms Co	Utica	N. Y.
21	Bronze	Thomas Pray, jr	Boston	Mass.
24	Shackles	Fletcher & Crowell Co	Portland	Me.

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